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ABSTRACT

The unit on logic is intended to teach critical thinking for gifted and talented students in grades 4-8. Sections are presented separately for students in grades 4-5 and 6-8. The younger students are instructed in such areas as scientific logic, math logic, spatial reasoning, deductive logic, inductive logic, and reasoning with analogies. The section for students in grades 6-8 presents activities designed to teach deductive reasoning, logical thinking (including truth values of "if-then" sentences, arguments, syllogisms, premises, and conclusions), and inductive thinking (including inferences, analogies, fallacies, open-ended problems, and applications). This document is part of a collection of materials from the Iowa Area Education Agency 7 Teacher Center Project. (CL)

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LOGIC

A Unit for 4-8 Graders

Especially Gifted and Talented

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TO THE STUDENT

Former students are often heard to say that school did not prepare them for the real world. They say that they had to learn things in school that they've never used after school. They say that they had to learn a lot of facts or figures or rules that don't matter in everyday life.

One of the most valuable things a school today can teach its students is how to think critically. Although every normal human being does some thinking, he isn't exactly a champion at critical thinking. Maybe that's one of the reasons the world is in such a mess today.

Thinking critically is a skill, just as skating, driving, and carpentry are skills. And like any other skill, it can be taught, it can be learned, and it can improve with practice and daily use.

The purpose of this book is to get you started in developing the skill of thinking critically. How to develop your ability to think critically is one thing you'll learn in school which will be of use to you in the real world!

Anita Harnadek
(In Critical Thinking, Book 1
Midwest Publications, 1976)

TABLE OF CONTENTS

	Page
INTRODUCTION TO TEACHERS	1
TEACHER QUESTIONNAIRE	2
DAY-TO-DAY SCHEDULE (Grades 4-5)	3
Part I	5
Part II	17
Part III	40
GRADES 6, 7, 8 - TO THE TEACHER	54
DAY-TO-DAY SCHEDULE (Grades 6, 7, 8)	56
Day 1 - Pre-Test and Introduction to Unit	57
DEDUCTIVE	
Day 2 - Review of Logic Elimination Problems	70
Day 3 - Logic Elimination Booklet	78
Day 4 - Logic Symbols	79
Day 5 - "Or" and "And" Sentences and Their Truth Values	82
Day 6 - Double Negatives	85
Day 7 - Necessary and Sufficient Conditions	87
Day 8 - Truth Values of "If-Then" Sentences	89
Day 9 - Proposition, Converse, Inverse and Contrapositive	93
Day 10 - "Only If" Sentences and Their Truth Values	96
Day 11 - Arguments, Syllogisms, Premises and Conclusions	100

* Pages 44-53, consisting of ten commercial advertisements extracted from magazines, have been deleted primarily for non-reproducibility

Page

INDUCTIVE

Day 12 - Inferences..... 103

Day 13 - Analogies..... 111

Day 14 - Cause and Effect..... 121

Day 15 - Relevant Information..... 125

Day 16 - Fallacies..... 134

Day 17 - Open-Ended Problems..... 141

Day 18 - Applications..... 145

Day 19 - Unit Review..... 147

Day 20 - Post-Test..... 147

BIBLIOGRAPHY..... 148

INTRODUCTION TO TEACHERS

Logic is an orderly and organized way of thinking. We use logic daily when we come to conclusions from day to day observations. We use logic when we try to figure out consequences of actions. We use logic when we read a statement or make an assumption and realize what the implications of that statement are or might be.

The purposes of teaching a unit on logic are to help students be more aware of and improve their own thinking processes. We want to help them grow in ability to analyze the logic, or illogic, for that matter, of others, whether it be listening to people in conversation, doing chemistry experiments, math problems or watching television, being bombarded by ads, listening to political speeches, reading the paper, as well as trying to convince others of something the student feels strongly about.

Now, about this unit. The first "half" is for 4-5 graders. It is by no means all inclusive. It touches on exposure areas in methods of logic and makes suggestions for ways you can expand those areas as you wish, as interests demand or time permits. More technical methods of logic can be added (from the second half, if you wish) as students progress in their abilities. A surplus of materials is included.

We urge you to read both sections of this logic unit, i.e. both the section for grades 4-5 and the section for grades 6-8 before deciding how to teach it. If you plan to use the 4-5 grade section, read it thoroughly well ahead of time, since you may want to order book sets, a film, filmstrips and make overheads and masters.

It will be much better for the students to have the logical problems discussed aloud in class, rather than having problems assigned and the teacher thereby just being on a one-to-one basis with students. Students will learn more how they and others think if they can get into free-wheeling discussions and become aware of many answers (not just one) to a question or problem. Don't expect the student to write down all the answers, but do expect the student to be able to defend his/her answers. So... as students get into this unit, we hope you will be able to step back to an increasing degree and let them have "at it."

The unit is geared towards 4-5 weeks of about 30 minutes each day.

Have some thinking fun!

TEACHER QUESTIONNAIRE

Evaluation of Unit

Name _____ (We really would like to have your name so we could talk with you about your ideas and suggestions.)

School _____

District _____

1. With what grade level did you use these materials? _____

2. Did you use this unit with G/T students? _____

   If so, were they multi-aged _____ or within a single classroom or grade? _____

3. Did you find this unit helpful as you taught your students general principles of logic?

   Yes _____ No _____ Somewhat _____

4. Were the materials and suggestions appropriate for grade level?

   Yes _____ No _____ Somewhat _____

5. Were directions clear enough for you to understand?

   Yes _____ No _____ Somewhat _____

Please give suggestions for improvement. We want them.

Please return to Susan Runkle, Cresthaven, Waterloo, or
Pam Tansey, Hoover Intermediate, Waterloo

DAY-TO-DAY SCHEDULE

Grades 4-5

Part I: Introduction

Day 1: Definition of logic
Pre-test
Purpose of studying logic
Some ways logic is used -
a. science - do experiment

Days 2 and 3: Some ways logic is used -
b. math

Day 4: Some ways logic is used -
b. math (finish)
c. advertisements
On this day also ask students to look for newspaper and magazine ads that show some more examples. They should bring them and save them for Days 19 and 20 in Part III.
If you have decided to have a panel of speakers as described in Part III, you will have already checked with participants before starting unit. If you are having students interview people instead, you will have checked with participants prior to this. Now you can ask for student volunteers to interview and have reports brought back for Day 21 in Part III.

Part II: Skills in Logic

Day 5: A. Deductive Logic and Inductive Logic - general definitions and examples - start on Deduction
If time, start on syllogisms

Day 6: Syllogisms
Ask students to bring in own syllogisms to share next day.

Day 7: Share student syllogisms and add some more of your own, if needed. Review patterns.

Day 8: Stories with use of matrix
Explain matrix

Day 9: Stories with use of matrix
Students can also bring in own

Day 10: Detective stories - with Encyclopedia Brown, Sherlock Holmes, filmstrips and book sets available. (See bibliography)

Day 11: B. Inductive Logic
Show movie, "Who's on First," and discuss ambiguous terms.

Days 12 and 13: Ambiguous terms and sentences and problems

Day 14: Cause and Effect

Day 15: Cause and Effect
Inferences

Day 16: Overlooking Facts

Day 17: Irrelevant Material

Day 18: Analogies
Remind students to have ads they can analyze.

Part III: Applications

Day 19: Go over ads

Day 20: Ads and newspaper articles

Day 21: Speakers, or audio or video cassettes

Day 22: Students work on ideas they want to persuade someone about

Day 23: Sharing those "arguments"

Day 24: Post-test - go over answers that day or next.

PART I

PRE-TEST

Use Little Miss Muffet

Read the story below and decide if each statement is true (T), false (F), or you don't have the information to give an answer (?). In deciding, you must follow these rules:

a. You must accept the story as true.

b. You may not use any past knowledge of the story.

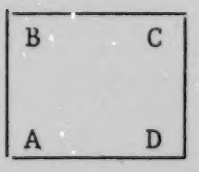
> Little Miss Muffet sat on a tuffet eating her curds and whey, when along came a spider and sat down beside her and frightened Miss Muffet away.

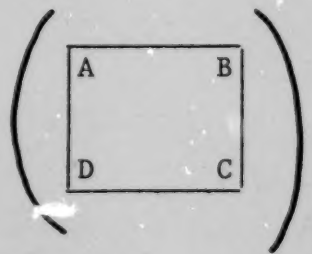
	T	F	?
1. Miss Muffet was frightened by the spider.	X		
2. Miss Muffet had already started to eat when the spider came along.	X		
3. Miss Muffet was watching TV when the spider came along.			X
4. The spider had been invited to lunch by Miss Muffet.			X
5. Maybe Miss Muffet wasn't really frightened - she just pretended to be.		X	
6. Miss Muffet didn't finish eating.			X
7. Miss Muffet moved away.	X		

8. If 3 pencils cost 10¢, how much will 24 pencils cost? (80¢)

9. Fence posts are placed 10 feet apart. How many posts are required to support 100 feet of fence in a straight line? (11)

10. If this were turned clockwise by one side, where would the lettered corners be?





Do these groups of statements make sense?

11. All tigers are cats.
Therefore all cats are tigers. Yes _____ No (X)

12. Dogs are animals.
Spaniels are dogs.
Therefore all spaniels are animals. Yes (X) No _____

Fill in the blank with what comes next.

13. 1, 2, 4, 8, 16, (32)

14. 0, 1, 1, 2, 3, 5, 8, (13)

15. Skin is to bark as arms are to (branches or limbs)

16. The senator's sister was recently married, but the father of the bride said the senator was not his son. The senator was his (daughter).

17. Nolan, Olik and Porter are a nurse, an osteopath and a paramedic.

    a. No person's name begins with the same first letter as her profession.

    b. Porter is not the osteopath.

    Who has each profession?

    (Nolan-osteopath; Olik-paramedic; Porter-nurse)

Some Ways Logic Can Be Used

Scientific Logic

Experiment: Have the apparatus ready for small groups or you may use the overhead and give one demonstration that all watch at the same time. It will be discussed here as though you are doing it on an overhead.

A. Equipment needed:

Overhead and screen
2 pyrex pie plates or other low clear glass containers
Water
Talcum powder in shaker
Black pepper in shaker
Paper clip (2" is fine)
Small cake of soap
Food color (optional) if you want to have the water lightly colored for effect

B. Procedure:

1. Place the container with clear or lightly colored water on the overhead. Explain what you are doing as you do it and ask students to observe and come to a conclusion after you are all finished.

2. Then shake pepper lightly over the surface of the water.

3. Dip the paper clip in the water at an edge of container and hold for 5 seconds and remove.

4. Then dip a small cake or slice of soap into the water at the same place and hold for 5 seconds.

5. Repeat Steps 1-4 using the talcum powder on fresh water in the other container. You could ask students to hold the paper clip and/or soap.

Have students state what they saw. Then have them come to a conclusion.

By using both the paper clip and soap they cannot conclude that the reaction from the soap would hold true to anything dipped into the water. By using both pepper and talcum they cannot conclude that it only happens with pepper.

What the students have been doing is inductive reasoning or inductive logic - coming to conclusions from observations.

Math Logic

1. A store sells boiled ham at $1.80 for a half-pound. How much will 2 pounds of boiled ham cost? ($1.80 X 4 (4 half-pounds in 2 pounds) = $7.20.)

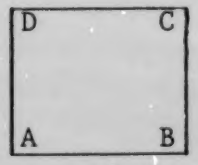
2. A doctor gives a girl 7 pills and tells her to take one every 3 hours, starting now. If the girl does as she is told, how many hours will it be until she has taken all the pills? (18 hours. The girl takes 1 now. She has 6 left which she takes one every 3 hours. 3 X 6 = 18.)

3. Suppose a hot air balloon floats by every 2 weeks and an old biplane comes by every 3 days. If both came by today, how long will it be before they come on the same day again? (42 days. 2 weeks = 14 days. 42 is the first number both 3 and 14 go into evenly.)

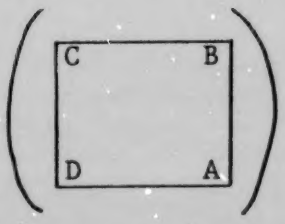
4. A train one mile long and traveling at a rate of sixty miles per hour enters a tunnel one mile long. How long will it take the train to clear the tunnel? (2 minutes. The train at 60 mph is going 1 mile a minute. Since the train is 1 mile long and the tunnel is 1 mile, the train has to go 2 miles before it is completely clear of the tunnel.)

Spatial Reasoning

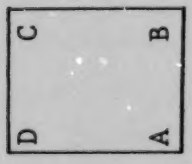
Draw the figure the way it would be if you:

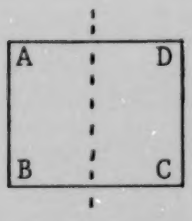
1. 

Turn it counterclockwise once (1 side)

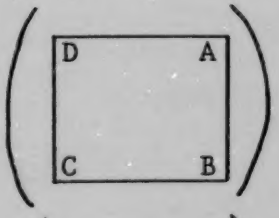


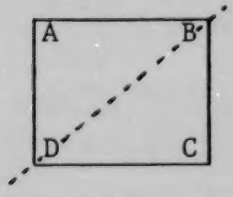
Some students may draw it with letters: You can say it's OK to shift letters so they're easier to read. Go over first problem. Then let them work on others and go into answers at the end.



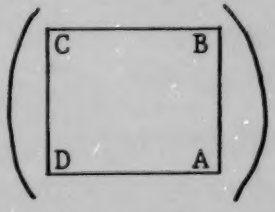
2. 

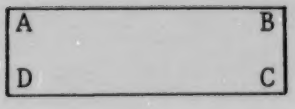
Flip this over on axis.



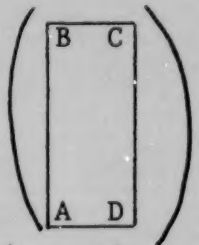
3. 

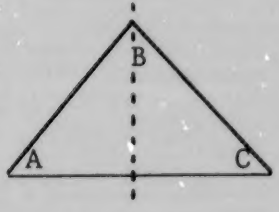
Flip over on axis.



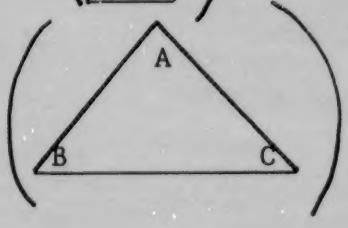
4. 

Turn it clockwise 3 times (i.e. 3 sides)



5. 

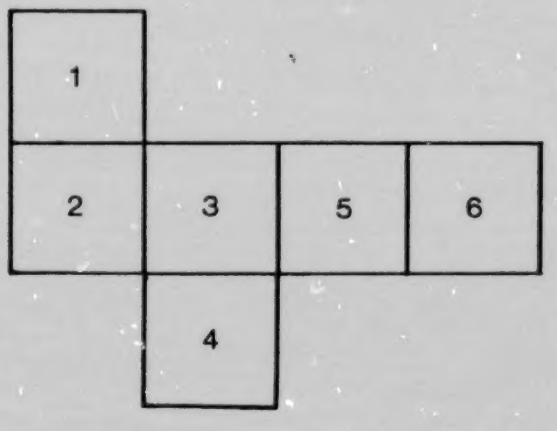
Turn it clockwise once and then flip it over.



(From Harnadek. Spatial Perception-B, Inductive Thinking Skills)

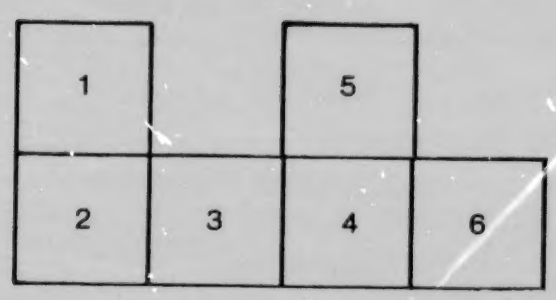
Problems 6-22. Each problem shows a pattern. Tell whether or not it is a pattern for a cube. If it is a pattern for a cube, tell how to fold it to make a cube. If it is not a pattern for a cube, tell how you know.

6.



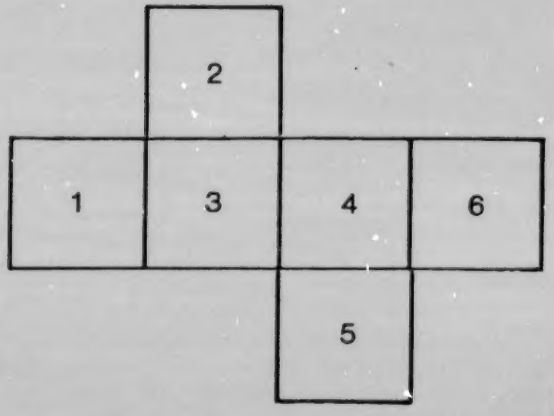
(Yes, if 3 is top, 6 is bottom)

7.



(No, 1 and 5 would overlap)

8.



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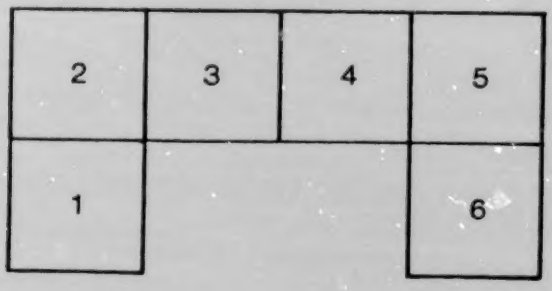
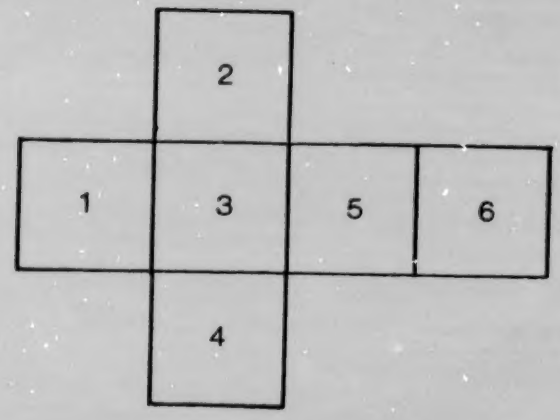
9.



(No, 1 and 6 overlap)

10.



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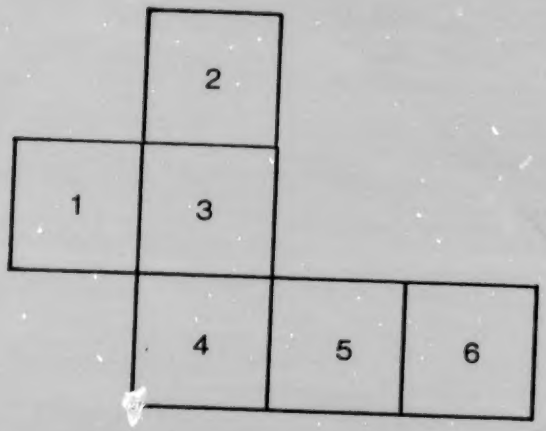
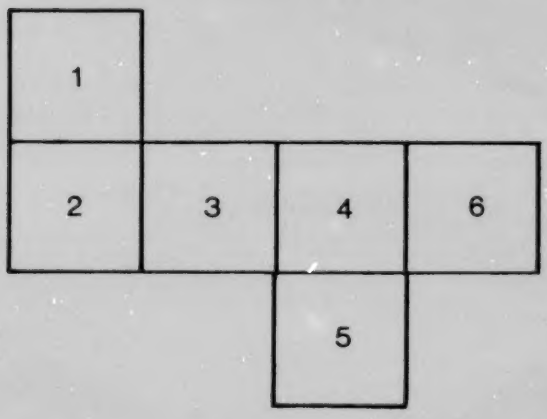
11.



(No, 2 and 6 overlap)

12.



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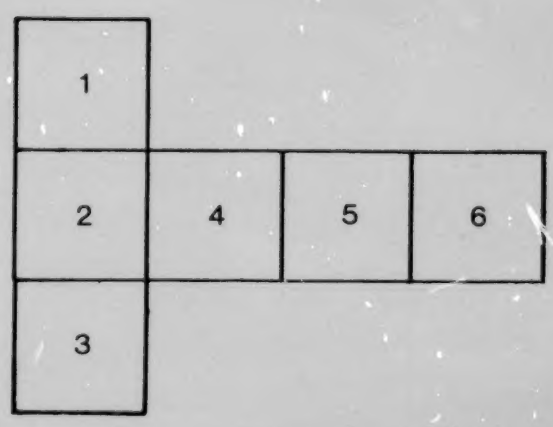
13.



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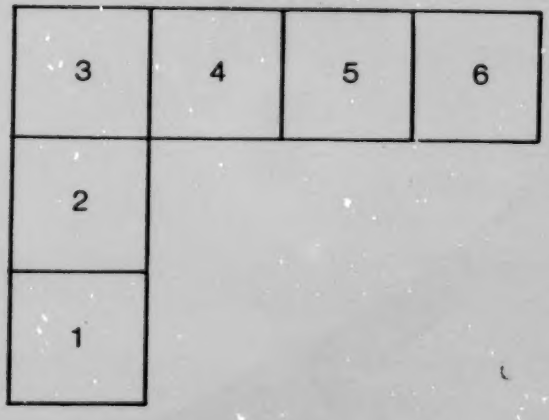
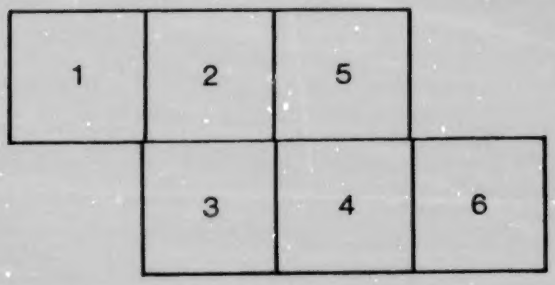
14.



(No, 5 and 1 overlap)

15.



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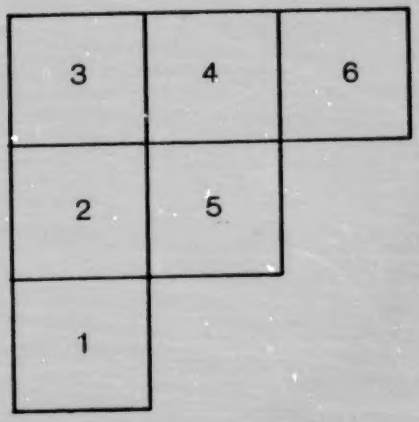
16.



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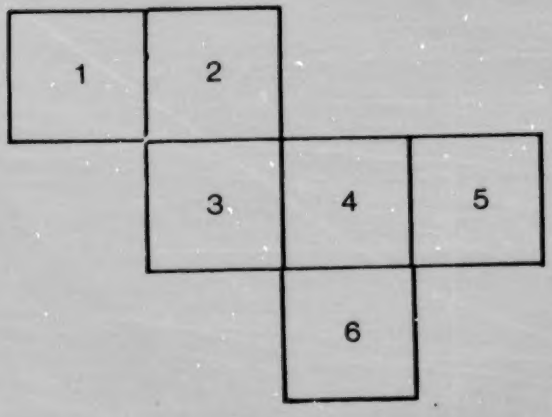
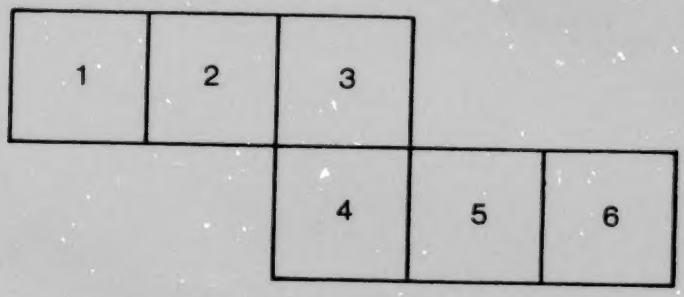
17.



(Yes, 5 is bottom)

18.



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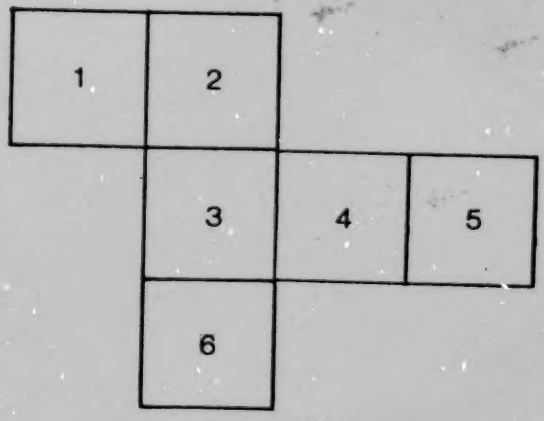
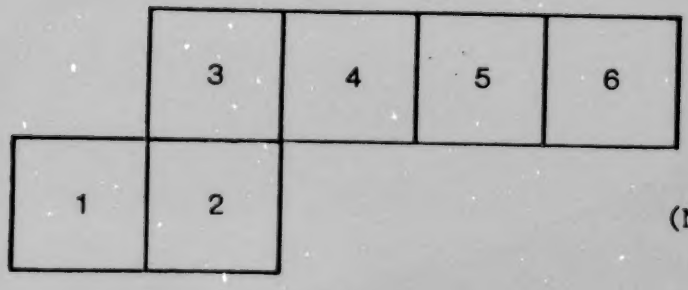
19.



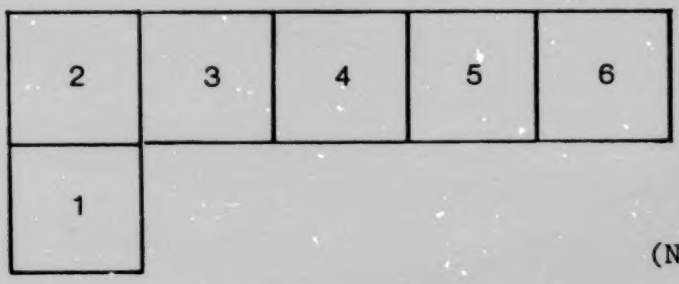
(Yes, 5 is bottom)

20.



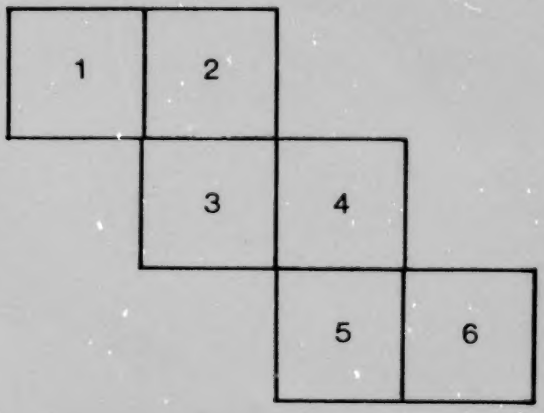
(No, 1 and 6 overlap)

21.



(No, 2 and 6 overlap)

22.



(Yes)

At this point, or later in Part III, the teacher may want to talk about computer logic (if conversant with it) and use a punch card to show the on/off logic.

Number and Letter Sequence

What number or letter comes next?

1. 1, 4, 7, 10, ___(13)___
2. 90, 85, 80, 75, ___(70)___
3. 1, 2, 4, 7, 11, ___(16)___
4. 4, 5, 7, 11, 19, ___(35)___
5. A, C, E, G, ___(I)___
6. S, M, T, W, T, ___(F for Friday)___
7. O, T, T, F, F, S, ___(S for seven)___
8. J, F, M, A, M, ___(J for June)___
9. 10, 8, 6, ___(4)___
10. 2, 4, 6, 3, 5, 7, 8, 10, ___(12)___
11. 1, 2, 3, 2, 3, 4, 3, ___(4)___

Have students make up some of their own to share.

Advertisements

1. "I had this throbbing right on the top of my head. Then I took Anacin."

   After taking Anacin, Mrs. M's throbbing headache was gone. She got rid of her headache - next time you get a headache, use Anacin.

2. "Smart people buy General Motors.
   Why not you?"

   This is really a statement of:

   Smart people buy General Motors.
   You are smart.
   Therefore, you should buy General Motors.

(Other ads are attached at back of 4-5 unit.)

NOTE: These sample ads have been deleted. See note on Table of Contents page.

PART II

DEFINITIONS

Argument: (not a quarrel) Reasoning in which one or more statements are used in support of another statement.

Assumptions: The ideas, principles, beliefs, or assumptions used as evidence in deductive reasoning. Propositions become premises when used in reasoning.

Connective: The word or words expressing the relationship between the two terms in a premise.

Deduction: A type of reasoning in which information about Specific instances is derived from assumptions or general principles.

Deductive inference: The mental process by which conclusions are drawn from premises.

Immediate inference: A deductive inference drawn from one premise.

Invalid: Arguments, syllogisms, conclusions, or inferences are invalid only when they are not forced by the premises.

Premises: The ideas, principles, beliefs, or assumptions used as evidence in deductive reasoning. Propositions become premises when used in reasoning.

Proposition: A statement of an idea.

Reliable: A premise is reliable only when it is known to be true. A conclusion is reliable only when it is valid and the premises are known to be true.

Sound: If an argument is sound, it is not only valid, but true as we know the truth to be.

Syllogism: An argument consisting of two premises and a conclusion drawn by deductive inference.

Term: The name of an object, idea, or class of objects or ideas.

Truth: The aim of the conclusion in inductive logic.

Unsound: May be valid, but if based on an untrue premise, the conclusion will not be true.

Valid: Arguments, syllogisms, conclusions, or inferences are valid only when they are forced by the premises. They can be valid without being true.

SYMBOLS

$\therefore$ means therefore.

In our everyday thinking, we usually don't stop to think, am I using deductive logic or inductive logic? Even if we did stop to think about it, we might not be able to say, "either deductive or inductive," because we are probably using a combination of both.

However, there <u>are</u> some general guidelines to help distinguish between these two main types of logic.

1. Inductive logic is more concerned with observation, as in scientific experiments, or coming to conclusions with either a sample of one (a hasty conclusion) or a sample of many. Inductive logic is also concerned with a truthful conclusion, or as truthful as the evidence allows.

   "All the chairs in this room are wooden." (You then find some chairs behind the couch, and they are metal.) Then it becomes:

   "Most of the chairs in this room are wooden," or

   "All but 4 chairs in this room are wooden."

   Inductive logic primarily goes from the specific or individual to the general statement.

2. Deductive logic, on the other hand, usually goes from the general (a premise, principle or assumption) and comes up with a specific. The conclusion may or may not be true. Deductive thinking is more concerned with the validity of the argument, the internal logic. The conclusion must be obvious from the assumptions or premises. If the conclusion is not obvious, clear, forced or necessary, then the conclusion is not valid. All the information in deductive logic must be there for the conclusion to be reached.

   There are four general situations possible in deductive logic in relation to truth and validity: (From Smith in NCTM Yearbook, 1959)

   a. A person may know in some way that the reasons in an argument are all true. He may also know that the inference is valid. He is then justified in stating that the conclusion is true.

All cats are animals.
Tigers are cats.
Therefore, tigers are animals.

b. A person may know that an inference is valid. He also may know that the conclusion is false. He then is justified in stating that at least one of the reasons is false.

All movie stars live in Hollywood.
Robert Redford is a movie star.
∴ Robert Redford lives in Hollywood.

c. A person may know in some way that all the reasons in an argument are true, but that the conclusion is false. He is then justified in stating that the inference is invalid.

Tigers are cats.
Cats are animals.
∴ All cats are tigers.

d. A person may know in some way that the conclusion of an argument is true. He may also know that the inference is valid. But from only this knowledge he cannot know whether the reasons are true or not.

All circles are quadrilaterals.
All squares are circles.
∴ All squares are quadrilaterals.

3. A general rule to keep in mind: There is no such thing as an exception that proves the rule. If there is an exception there is no rule.

Now, before you start on deductive and inductive reasoning or logic, here's a quick review and comparison:

One difference between deductive and inductive arguments is that the premises in a deductive argument contain all the information needed in order to reach a conclusion that must follow. The conclusion of an inductive argument is reached by going beyond information contained in the premises. Thus our conclusion can never be absolutely true, although it can have a high probability of being true.

Most of the arguments one encounters in daily life are of the inductive type.

Deductive: All the peaches in that box are ripe.
All these peaches are from that box.
Therefore, all these peaches are ripe.

The conclusion follows with necessity from the premises.

Inductive: All these peaches are from that box.
All these peaches are ripe.
Therefore, all the peaches in that box are ripe.

The conclusion is derivable from the premises only with probability.

DEDUCTIVE LOGIC

Let's start with syllogisms.

A syllogism is an argument consisting of two premises and a conclusion drawn by deductive inference. There are some rules regarding syllogisms. There are three basic terms, each used twice.

A B
All cats are animals.
C A
All tigers are cats.
C B
∴All tigers are animals.

The first two statements are premises. The third one is a conclusion that is forced by the two statements. When the premises are true and the inferences are valid, then the conclusion is sound. (It is true and valid.)

The class can go over these to see if each one is valid.

A B
All men are mortal.
C A
President Reagan is a man.
C B
∴President Reagan is mortal.

(Yes, this one is valid. Notice the pattern.)

A B
All weeds are plants.
C B
The flower is a plant.
A C
∴All weeds are flowers.

(This one doesn't work. You're trying to do something about "Therefore all flowers are" - But this doesn't hold. Just because both are plants doesn't make them equal or the same.)

All Greeks have beards.
Zeno is a Greek.
∴Zeno has a beard.

(The argument is valid. All Greeks may not have beards in reality, but it's the premise for this argument.)

No matadors are pirates.
Some Spaniards are matadors.
∴All Spaniards are pirates.

(This doesn't work. The term "Some Spaniards" has been changed to "all." See below for a valid conclusion and sound argument.)

No matadors are pirates.
Some Spaniards are matadors.
∴Some Spaniards are not pirates.

Words of five letters are bigger than words of four letters.
Seven is a word of five letters and nine is a word of four letters.
Therefore, seven is bigger than nine.

(The word "seven" is bigger or larger or longer than the word "nine," but the number "7" is not larger in quantity than the number "9.")

No two-year-olds are as tall as high school students.
Some race horses are two-year-olds.
Therefore, some race horses are not as tall as high school students.

(Doesn't work because two-year-olds (people) are not the same as two-year-old horses. Meaning of term has changed. Somewhat like changing horses in midstream.)

John is a brother of George.
Sam is a brother of John.
Therefore, Sam and George are brothers.

(Yes, valid.)

Sara is a friend of Jane.
Lisa is a friend of Jane.
Therefore, Lisa and Sara are friends.

(Different from previous one. "Friend" is a less restrictive term than "brother." Could be changed to: All of Jane's friends are friends.
Lisa and Sara are friends of Jane.
∴ Lisa and Sara are friends.)

The citizens of New York are of many different national backgrounds.
Joe Doakes is a citizen of New York.
Therefore, Joe Doakes is of many different national backgrounds.

(Not necessarily. Just because the group is composed of many backgrounds does not mean that a particular individual is also.)

Only man is rational.
No woman is a man.
Therefore, no woman is rational.

(No. The meaning of "man" has changed in effect making 4 terms in this syllogism. Remember only 3 are allowed.)

All cats are animals.
All dogs are animals.
Therefore, all dogs are cats.

(Doesn't work. Both can belong to larger group, but not be the same. Pattern is wrong also. It is AB, CB, CA, rather than AB, CA, CB, as it should be.)

John's ravings are no news.
No news is good news.
Therefore, John's ravings are good news.

(Meanings get switched by having an irrelevant chiche tossed in as the second premise.)

Moderate people avoid intoxicating things.
The fragrance of orange blossoms is intoxicating.
Moderate people avoid the fragrance of orange blossoms.

(No. Meaning of intoxicating is changed, thereby adding an extra term.)

John is the uncle of Robert.
Robert is the uncle of William.
Therefore, William is the uncle of John.

(Doesn't work with the relationships.)

Most students are in school to learn.
Jeff is a student.
Therefore, Jeff is in school to learn.

(Again, can't assume individual necessarily reflects group he/she is in.)

All who drive on highways during holidays
risk their lives.
Carol drove on highways on Labor Day.
Therefore, Carol risked her life.

(Sound syllogism.)

Some statesmen write good books.
All psychologists can help people.
Therefore, ?

(These two statements or premises are not related. You can't make a logical deduction from them.)

All who wear white gloves are silly.
All rabbits wear white gloves.
All rabbits are silly.

(Valid argument, but unsound.)

Use of Matrix in a Logic Problem

Objective: The student will learn how to use a matrix in solving a deductive problem. (Examples given are from Harnadek, Mind Benders.)

Example: The favorite sports of Brian, Horace, Ian and Tammy are baseball, hiking, ice-skating, and tennis.

1. No person's name begins with the same letter as his or her sport.
2. Tammy and Horace don't like team sports.
3. Horace and Brian don't like cold weather sports.

What is each person's favorite sport?

To help in this solution, make a matrix like this and label. To explain how to do this, there will be several drawn for just this one problem. In reality, you will need only one matrix per problem.

	baseball	hiking	ice-skating	tennis
B	1			
H		1		
I			1	
T				1

First clue: No person's name begins with same letter as his/her sport. So fill in with a "1" those squares that are eliminated.

	baseball	hiking	ice-skating	tennis
B	1			
H	2	1		
I	2 yes	2	1	2
T	2			1

Second clue: Tammy and Horace don't like team sports. The only team sport is baseball, so we put a "2" in those squares that are eliminated. That immediately leaves only Ian with baseball. So put an X^2, a $\checkmark^2$ or a yes^2 in that square. Because we now know Ian's favorite, we eliminate his squares under the other sports.

	baseball	hiking	ice-skating	tennis
B	1	3 yes	3	3
H	2	1	3	3 yes
I	2 yes	2	1	2
T	2	3	3 yes	1

Third clue: Horace and Brian don't like cold weather sports. This eliminates them under ice-skating, so we put a "3" there. This automatically indicates that Horace likes tennis, thereby eliminating Brian from that. Tammy is the only one left for ice-skating and hiking is the only sport left for Brian.

Remember with deduction problems, there is no doubt as to the conclusion because all the information is given in the problem, and the answer is forced by necessity.

Go over how to use a matrix with your students. Give them the problem on a piece of paper. You show a blank matrix on an overhead. They then construct their own. Then lead them step by step by asking what each clue leads to. After going over the example with them, give them another problem on paper and let them "at it." You may want to put a matrix on the overhead so they don't get bogged down. Then let students work on it either by small groups (eg. a table group) or as individuals. Then ask someone to explain reasoning on overhead to class. Let them work on others. The answers are mapped out.

I. Al, Brad, and Chuck play on a football team. Their positions are fullback, halfback, and quarterback.

1. Al and the quarterback threw a party for Chuck.
2. Al is not the fullback.

	F	H	Q
A	2	2 yes	1
B	1	1	1 yes
C	2 yes	2	1

II. Four children, Hisashi, Marguerita, Nuhad, and Phoebe, are playing hide-and-seek at Hisashi's house. One of the children is "it." The other three are hiding in three different places - behind the garage, behind the house, and behind a tree.

1. From where he is, Hisashi can see the girl who is hiding behind the house.
2. Nuhad can't see the garage from his position.
3. From where she's hiding, Phoebe can see the girl who is "it."

Who is "it?" Where is each child hiding?

	It	garage	house	tree
H	3	3 yes	1	3
M	3 yes	3	3	3
N	3	2	1	3 yes
P	3	3	3 yes	3

III. Juan, Juanita, Marie and Ramon are 10, 12, 13, and 14 years old.

1. Marie is older than Ramon and younger than Juan.
2. Juanita is younger than Marie and older than Ramon.

What is each person's age?

	10	12	13	14
Juan	1	2	2	2 yes
Juanita	2	2 yes	2	2
Marie	1	2	2 yes	1
Ramon	2 yes	2	2	1

IV. The last names of Ivan, Julie, and Kinte are Lohmer, Morton, and Newman.

1. Newman is Kinte's aunt.
2. Ivan's name is not Lohmer.

Match up each person's first and last names.

	L	M	N
I	2	yes	1
J	1	1	1 yes
K	yes	2	1

V. Ada, Beth, Christine and Denise each have a different job (model for mascara ads, plumber, radio announcer, trapeze artist). In every case except Denise's, something happened early this morning which made it impossible for the woman to do her job today.

1. Ada pulled a muscle in her left leg.
2. Beth came down with laryngitis.
3. Christine bumped into a door and got a black eye.

Find each woman's job.

	M	P	RA	TA
A	1	1	1	1 yes
B	2	2	2 yes	1
C	3 yes	3	2	1
D	3	yes	2	1

VI. Two girls (Harriet and Kathy) and two boys (Isaac and Jack) all had A's in science on the last test. Their last names are Asher, Barber, Candle and Davis. From the clues below, match their first and last names.

1. Jack's last name was not Asher or Candle.
2. Kathy's last name was not Barber or Davis.
3. Harriet's last name was not Asher or Barber.
4. Isaac's last name was not Asher or Candle.
5. Jack's last name was shorter than Isaac's.

	A	B	C	D
H	3	3	4 yes	4
I	4	5 yes	4	5
J	1	5	1	5 yes
K	4 yes	2	2	4

Students may want to make up some of their own and bring in to share the next day. (As you can see, you can easily expand this unit in the area of time.)

Another excellent tool to use with deductive problems and matrixes is Who Owns the Unicorn? It can be cut up, laminated and made into hands-on, tactile deductive games, and/or made into overheads where they can be used for demonstration or games.

DETECTIVE STORIES

Have some fun with this day, too. You can read some Encyclopedia Brown stories to the students and let them figure out the ending. Or show some Encyclopedia filmstrips to the class. Each filmstrip pauses near the end to let the audience figure the solution before it is given. Be sure to caution the students who might have seen the strips or read a particular story not to give the answer away.

You might also want to read a Sherlock Holmes short story or show some Sherlock Holmes filmstrips, or begin reading a Sherlock Holmes story and finish it later in the unit.

Stories suggested:

The Adventure of the Speckled Band
The Red-headed League
The Adventure of the Copper Beeches

INDUCTIVE LOGIC

Objective: Students will gain familiarity with inductive logic and gain some basic skills in it.

Most of the problems we are faced with day by day require inductive thinking skills. We don't have all the information on a problem, but we must make judgments about what we do have. With new information at a later date, we may change our decision or conclusion. Often, however, when we look at the information we get, we have to be aware of prejudiced observations, slanted statements, irrelevant information, mixed up thinking about cause and effect, and difficulties with words that have a variety of meanings, or are used in ambiguous ways.

The first few days in working with inductive reasoning will deal with this aspect. The last days will help students familiarize themselves with fallacies in reasoning and with skills in reasoning with analogies.

Show the movie "Who's on First?" (The State Library owns it and it may be secured through your local public library. If you aren't able to book the movie, there is an audio cassette commercially available.) This is a short subject, about 5 minutes, with Abbott and Costello. A good introduction to confusion with words.

Discuss some of these with students:

Is it a sunny day? Completely sunny? or partly sunny? What is the difference between partly cloudy and partly sunny?

What is old? Old for a person is different than "old" for a dog. Just what is old for a person? Does it differ with the age of the person defining it? (Students could do an informal survey on this.)

When is a person bald? When all hair is gone? When there's a shiny spot in back? Is a man bald is he loses hair in front, not in the back?

What is late at night? How does it differ with the person and the situation?

What is cold? In the winter 50 degrees F. is viewed differently than 50 degrees F. in July in Iowa.

Sometimes it's important to use a general word--"animals" or "living things" rather than a specific.

Have students arrange the following groups of words from general to specific. Hopefully, it will help them become more aware as they use words in reasoning and hear or read them.

cat, Siamese, living thing, animal (living thing, animal, cat, Siamese)

Chevrolet, vehicle, means of transportation, automobile (means of transportation, vehicle, automobile, Chevrolet)

singer, Donna Summer, musician, artist (artist, musician, singer, Donna Summer)

apple, fruit, Golden Delicious, food (food, fruit, apple, Golden Delicious)

student, elementary student, fourth grader, person (person, student, elementary student, fourth grader)

female, human, animal, girl (animal, human, female, girl)

Here are some exercises:

Complete each sentence with the first thought that hits you. Don't worry if others will agree with what you write.

1. Television is _____
2. School is _____
3. Girls are _____
4. Boys are _____
5. Baseball is _____
6. Doctors are _____
7. Advertisements are _____

What would you mean if you made the following statements: Write one or two sentences about each one.

1. He's stubborn.

2. She's conceited.

3. That was a good meal.

4. I didn't have time to do my homework last night.

We've already seen in previous examples how words have ambiguous meanings.

man (meaning mankind) and man (specifically)
intoxicating (to make someone drunk) or enthusiastic

We can see how sentence construction can be ambiguous. Discuss some of these:

Jack is the one in the car with the black hair.

Sitting on the edge of the bed, his eyes followed the moth.

Killer says Dead Man was chasing him with drawn razor. (Newspaper headline)

If you don't go to other people's funerals, they won't come to yours.

Just received! A new stock of sports shirts for men with 15 to 19 necks. (ad.)

The marriage of Miss Anna Black and Mr. Willis Dash, which was announced in this paper a few weeks ago, was a mistake and we wish to correct it.

Police authorities are finding the solution of murders more and more difficult because the victims are unwilling to cooperate with the police.

What is meant by hoping that someone "gets everything he deserves?"

1. Mr. S.: Gene is a big discipline problem in my classroom. He's always asking a question or making a comment without raising his hand. He interrupts whenever the mood hits him."

   Mr. W.: He does that in my classroom, too, but I don't think that makes him a big discipline problem. His questions and comments are always related to what the lesson is about. In fact, I think he does it just because he's interested in what's going on. I wish more students were like him.

   Mr. S.: I can't believe you're serious. I can't imagine anyone's wanting more discipline problems.

   What seems to be Mr. S's idea of a student who is a discipline problem?

   Does Mr. W. seem to agree with Mr. S. on this view?

   In view of what Mr. W. said, how do you account for Mr. S's last two statements?

2. A city ordinance reads: It shall be unlawful for any person to keep, harbor, own, or raise any livestock, cattle, horse, duck, goose, chicken, goat, rabbit, snake, pig, or sheep in this city.

   For each problem, assume the person is in that city when he does what the problem says. Tell whether or not the person is violating the ordinance. If you cannot decide, tell what you need to know in order to decide.

   a. Mr. Trainer raises hogs in his back yard.

   b. Mr. Arbor has a pet buffalo which he takes on walks around the block.

   c. Jill has a Shetland pony which she rides in her back yard.

   d. Mrs. Brown keeps a pet rooster in her house and yard.

   e. Mr. Rownd keeps a pet gander in his back yard.

   f. The Carters raise minks which they sell to fur processors.

   g. Mr. Gains keeps bees in his back yard. He uses the honey they make.

   h. The Nomans have a relative living with them. They are ashamed of him, for he is known as the black sheep of the family.

i. Mr. Johnson is a plumber. He owns a plumber's snake--a long and flexible cable--which he uses to unplug clogged drains.

j. Dave has a pet dog.

The above are examples of fallacies of reasoning caused by vague or ambiguous words or ambiguous wording.

They hinder getting at the "truth." And getting at the truth is the main job of inductive reasoning. There are some other obstacles or thinking fallacies that get in the way of truth or sound reasoning with the best information available.

One of these reasoning fallacies has to do with CAUSE and EFFECT.

A. Superstitions in general are based upon faulty views of cause and effect. Here are some, students can add more:

No thirteenth floor is labeled as such in a hotel. Even though the floor above the twelfth floor is labeled the fourteenth, it is, of course, the thirteenth.

Step on a crack, break your mother's back.

Don't walk under a ladder.

Seven years bad luck if you break a mirror.

Bad luck if a black cat crosses your path.

It will be a hard winter because hollyberries are abundant.

B. The fact that two events occur at about the same time doesn't mean that one causes the other.

When the crocuses are in bloom, the robins come.

C. The cause and effect might be switched.

When robins come, we will have warm weather.

"Boy, have I got this guy conditioned! Every time I press the bar down, he drops in a piece of food."

D. Here are some problems with cause and effect for students to discuss:

1. Wilma has noticed that whenever it snows, it is very cold outside. Does snow cause cold weather? Explain.

2. Tina noticed that whenever the clock says it is 11:00 P.M., it is dark outside. She thinks the clock causes darkness. How might someone show her that she is wrong?

   (One way would be to set the clock to another time.)

3. Kathy has found out that drivers who pay a lot more than usual for auto insurance have bad driving records. She says that if the insurance companies would just charge them the same as everyone else, then these drivers would be good drivers, too. What do you think of this?

4. Charles is 6 years old. Sometimes his mother lets him play outside in the rain and sometimes she doesn't. He has noticed that there is never any lightning or thunder when he's playing in the rain, but there is nearly always lightning and thunder when his mother won't let him play in the rain. He figures that his playing in the rain is what keeps the lightning and thunder away. What do you think?

5. Mr. Tarber is crabby and doesn't like other people. He has noticed that every time his dog barks, someone comes to the door. He wants his dog to stop barking so that people will stop coming to his door. What's wrong with this thinking?

6. A salesman went from town to town selling bottles of Miracle Cold Cure. He promised people that if they'd drink Miracle Cold Cure for seven days, either their colds would be cured, or he'd give them double their money back. He very seldom had to refund any money, for, by the end of seven days, most of the people with colds had been cured, and the others felt so much better that they were satisfied that their money had been well spent. What do you think?

(This same general reasoning can be applied to many ads. Our product will cause you to become beautiful, healthy, sweet smelling, popular, etc.)

INFERENCES

We infer from single statements as well as multiple statements. Sometimes we even infer from what we observe, with no words being involved. Sometimes we infer what we shouldn't and sometimes we get a message very clearly.

Tom saw a sign: SLOW
DEER
CROSSING

He inferred that slow deer crossed the highway there. Is that a good inference? (No.)

Jane went to Ann's house to play with her. Ann answered the door, didn't speak to Jane and slammed the door shut. Jane inferred that Ann must be mad at her about something. (Good inference.)

The following three examples are from Anita Harnadek. If you wish to pursue this area of logic further, it will be worthwhile to purchase Inferences-A and Inferences-B.

Five people went on a picnic. All had stomach cramps later that day. Each person wrote down what he or she had eaten at the picnic.

The first person had ham, pickles, lemonade, bread, mustard, potato salad, and pie.

The second person had chicken, potato salad, cake, iced tea, pickles, bread, and deviled eggs.

The third person had ham, bread, potato salad, mustard, lemonade, and deviled eggs.

The fourth person had chicken, bread, pickles, pie, potato salad, iced tea, and ham.

The fifth person had ham, pickles, iced tea, potato salad, mustard, pie, and cake.

Some food they ate at the picnic caused their stomach cramps. What food do you think caused the cramps? How come? (Potato salad)

Mr. and Mrs. Rodriguez like classical music. They have a good collection of classical music records. Is it reasonable to infer that they don't like rock and roll? How come?

Mrs. Johnson sees a car coming down the street. There is no other traffic around the car. The car is not going fast, but it is weaving back and forth between lanes. What is a reasonable inference for Mrs. Johnson to make?

Teacher center

OVERLOOKING FACTS

There are some areas that we will mention briefly so that students can become aware of them, but we won't spend alot of time on each of them.

Fallacies caused by overlooking the facts:

A. Sweeping generalization--Making a big statement and then assuming it applies to everyone or everything.

This team is the top team in Waterloo, so I know each member is better than any member of another team.

I can't tear this phone book in half, so then I can't tear a page in half.

B. Hasty generalization--Observing one or two samples and making a generalization, or coming to a conclusion about everything of that nature.

I know one person from Waterloo and he's terrible. I wouldn't like any person from Waterloo.

I tore one page of this phone book in half, so I know I can tear the whole book in half.

Two strawberries in that basket are good, so I know the whole basket is good..

That problem was easy. I'm sure all the rest in the book are easy.

He burned the toast. He's a terrible cook.

C. Mindsets--Often when we try to think we don't keep our minds open to all the options. A few years ago we assumed (falsely) that judges would be white men, nurses would be women. By prejudging options we really aren't thinking rationally. We do this not only in relation to men and women, but to minority groups, people who go to another school, who live in another town, state, or country.

Here are a few examples to help us think about this:

1. A marine received a letter signed "Your loving spouse" but the letter was not from the marine's wife. The marine is the (wife).

2. If the butcher is not the grandson of the butcher's father's father, the butcher must be the (granddaughter).

3. The patient was the doctor's son, but the doctor was not the patient's father. How come? (mother).

4. Four lawyers and two typists attended a corporation meeting. The typists decided to have lunch together and both agreed that although they had excellent marriages, they would never be called good wives because they were good (husbands).

D. "Either....or"--Saying that only two choices exist, when in fact, there may be several.

People are either rich or poor.

Water is either hot or cold.

If you don't get all A's, you're a failure.

I want a million dollars or nothing.

E. Begging the Question--It assumes a question before the one that is asked.

"Have you stopped beating your wife?" is the classic example. No matter how it's answered, it is assuming that you have been beating your wife.

Did Mary ever give up her bad habits? (It assumes she had some bad habits.)

What did you use to wipe your fingerprints from the gun?

When should you buy your first Cadillac?

Does the cold tablet you're taking now start to work in 15 seconds?

F. Circular reasoning--Defining something in terms of itself, or concluding with the starting premise. This never gets anywhere.

When large numbers of people are out of work, unemployment results.

Squeaky Clean soap is bought by more people because it is the most popular soap.

IRRELEVANT MATERIAL

IRRELEVANT MATERIAL--Many times issues or statements are put into an argument or line of reasoning that really don't have a thing to do with the purpose of the argument.

Here are some examples to help you understand what relevant and irrelevant mean.

Mary is feeling ill. She is going to the doctor later. When the doctor asks why she is there, it will be relevant if Mary tells him about the stomach cramps she's been having. It will be irrelevant if she tells him that she likes his new car.

Ms. Brown wants to be our mayor. The degree of her honesty is relevant to the question of whether or not she would be a good mayor. The number of children she has is not relevant to this question. The extent of her ability as a leader is relevant. The color of her hair is irrelevant.

In addition to these irrelevant statements, here are some other kinds that students this age can become familiar with. They will be more aware of them as they listen to and see ads and campaigns.

1. name calling or personal attack--It has nothing to do with advancing the argument.

   You're stupid, you don't know what you're talking about.

   Would you listen to anyone who has had a car accident?

   I won't say he's a communist, but I know he knows someone who is.

2. appeal to "authority"--Because someone is an authority in one field does not necessarily make that person an authority in another field.

   Pete Rose advocating a particular car.

   A librarian saying which tennis racket is best.

   A football player telling you what kind of furniture to buy.

   "Everyone" becomes an authority in "Everyone has one, or does it." Related to this is snob appeal:

      Only the best people use this.

      Be the first in your neighborhood to own thus-and-so.

3. appeal to pity--An attempt to appeal to someone in a way that is completely extraneous to the issue.

   A classic case is where the defendant, upon being convicted of killing both his parents, pleaded for mercy because he was an orphan.

   Even though I don't have the qualifications for the job, I should get it because my wife is sick.

   My mother will feel badly if you give me a low score.

Exercises in deciding upon relevancy:

Royce wanted a pet dog. His parents said no. He asked again later. They said he'd have to give them some good reasons to have a dog before they'd let him have one. Tell which of Royce's statements are relevant to what his parents said.

a. All of my friends have dogs.
b. A lot of U.S. Presidents have had dogs.
c. I want a dog.
d. It will teach me responsibility.
e. It will keep me company.
f. It will protect me in case strangers come around.
g. It will give me something to show off to the other kids.
h. Someone famous once said, "Every boy should have a dog."

Sally gets paid on an hourly basis. She was trying to figure out whether or not her paycheck was correct. She did not work the same number of hours this week as last week. Her friend, Jean, was trying to help her. Tell which of Jean's questions were relevant to Sally's problem.

a. How many hours did you work each day?
b. Did you get an invitation to Lou's party next week?
c. Does the payroll office often make mistakes?
d. Are you supposed to get overtime rates for some of the hours you worked?
e. Will you get the raise you asked for?
f. Will you be able to take part of your vacation next week?
g. How much is your regular hourly rate?
h. Will the company do anything about it if you find out they made a mistake in your check?

You and your friend have a new game. You are reading the directions to find out how to play it. You come to a word you don't understand. Your friend doesn't know what it means, either. You read a little further but that doesn't clear up the word's meaning. Tell which of your friend's statements sound like good ways to find out what the word means.

a. Your mother is in the next room. Ask her.
b. See how many vowels the word has.
c. Look it up in the dictionary.
d. Ask your two-year old sister.
e. Write a letter to the editor of the newspaper you read.
f. Spell it backwards and see if it makes any sense that way.
g. We can figure cut the game without knowing that one word, so let's not bother with it.

REASONING WITH ANALOGIES

Analogies are ways in which you compare or relate words and ideas to each other in a similar way.

For example:

cow is to moo as dog is to bark

kind is to unkind as nice is to (choose one)

big, considerate, hungry, nasty

Choose the word that will complete the analogy:

look, see	listen (ears, hear, stop, warning)
baseball, diamond	tennis (ball, court, net, sport)
buy, bought	give (gave, give, gived, got)
wide, width	long (altitude, breadth, height, length)
music, listen	book (pages, pictures, read, words)
hat, head	slippers (ears, feet, hands, neck)

Choose the best pair of words to complete the analogy:

present, past	(am, are; are, were; give, take; then, now)
black, gray	(blue, green; light, dark; red, pink; white, cream)
kitten, cat	(adult, baby; colt, cow; dog, pup; tadpole, frog)
soup, bowl	(cook, pan; glass, milk; meat, plate; spoon, soup)
snow, ice	(hard, soft; hockey, sledding; ski, skate; Thanksgiving, Christmas)

Fill a word in on your own.

past, future	yesterday, (tomorrow)
start, stop	on, (off)
past, future	before, (after)
light, dark	day, (night)
hot, warm	cold, (cool)
inside, outside	indoors, (outdoors)
trust, distrust	friend, (enemy, foe, opponent)
fact, real	fiction, (non-fiction)

Make up some of your own.

PART III

Advertisements

Go over ads students brought in.

What are assumptions or premises?

What is the conclusion the advertiser wants you to reach?

What are the inferences to get you from the premises to the conclusion?

Have students present their ads and their answers to the above questions. Open up discussion.

Do the same for articles from newspapers that students might have, especially letters to the editor or editorials. You may want to use following articles:

From Glimpse, a publication of the International Society for General Semantics, published in the Des Moines Register.

ONE OR THE OTHER

U.S. House of Representatives Concurrent Resolution 220 proposes the establishment of a federal strike force to combat organized crime perpetrated by "outlaw motorcycle gangs."

Several months ago, Jon Smith wrote to the magazine American Motorcyclist saying: "Anyone who would oppose Resolution 220 would have to be one of two things. Either they are outlaws themselves or else they know absolutely nothing about outlaws."

Warren Stump sends us a copy of his letter from the American Motorcyclist, in which he responds to Smith's message:

"The error Mr. Smith makes is one I have been taught to call the "two-value orientation"--insisting that something has to be either this way or that way. We are all prone to this kind of unclear thinking at various times and/or on certain subjects..

"Here's an example that Mr. Smith can identify with: I can make a good case for the following 'truth': There are more criminals named John than there are named Malthazar. This 'truth' should make us more cautious in the way we regard everyone named John. Similarly, I can make a case that there are more people named Smith who are criminally insane than there are people named Shagnastee.

"Now watch what happens when I put together these two 'truths,' which are so easily proven: Clearly, we can take an important step in combating crime if we deal severely with people named both John and Smith. Do you think we should hang them all by their thumbs or should we (decapitate) them? One-issue folks--some even in the motorcycle press--use the two-valued orientation a lot. Recognize it when somebody tries to use it on you or vice versa. In bikes, it's a choice between Harleys and junk, right?"

From a Letter to the Editor, published in the Des Moines Register:

> Regarding...the June 19 news article on 1981 motorcycle deaths in Iowa: Why not do a little research on this subject instead of implying motorcyclists are not complying with the law? For instance, how many four-wheeled vehicles caused these accidents?
>
> Motorcyclists do pay attention to safety laws; it's their necks. It's the four-wheeled-vehicle drivers who need lessons on safety.

If possible, a panel of speakers on how they use logic in their professions. If you can't get speakers at same time for panel, they might come individually, or students could do a videotape interview, a audiotape interview, or a note-taking interview and present to class.

Suggestions:
- computer programming -
- law - evidence and trials
- library - how librarians decide where books go when there are choices
- advertising - how to sell
- politics - how to get elected; how to get bills passed

Ideas that students want to persuade someone about. Could be:

- Where to go on vacation
- Desire to have lessons in (karate, gymnastics, drums, trombone, tennis)
- Increased allowance
- Later bedtime
- Wanting a pet - dog, bird, cat, guinea pig, alligator.

How to do it:

I Think I Should Be Able To Stay Up Until 9:00.

- I don't need as much sleep as I used to.
- Dr. R_____ says I am healthy.
- I wake up on my own at 7:00; I could sleep until 7:30 and still have the same amount of sleep.
- I'm not cranky (most of the time)
- Since I am now taking gymnastics lessons and violin lessons, I'd like 30 more minutes in the evening before I go to bed.

Be sure to check for validity of argument and conclusion and truth of premises.

POST-TEST

I. Read the story below and decide if each statement is true (T), false (F), or you don't have enough information to give an answer (?).

SNOW WHITE

Snow White's wicked stepmother hated her and wanted to dispose of her. The stepmother mixed a special potion and dipped an apple into this potion. She then disguised herself and tricked Snow White into taking a bite from the apple. As soon as she took a bite from the apple, Snow White fell to the floor, unconscious.

	T	F	?
1. Snow White fell to the floor as a result of taking a bite from the apple.			X
2. The apple was poisoned.			X
3. The stepmother tricked Snow White.	X		
4. The stepmother disguised herself as an old woman selling apples.			X
5. The seven dwarfs got even for Snow White's death by killing the stepmother.			X
6. The stepmother was wicked.	X		
7. The stepmother loved Snow White.		X	

II. Write the answers to the following problems in the space given.

8. How many handkerchiefs at 3 for $2.00 can you buy for $10.00? (15)

9. A runner leaves a marker every two miles on a long-distance course. He makes certain there is a marker at the beginning and end of the ten-mile course. How many markers did he place? (6)

10. If this were turned counterclockwise by one side, where would the letters be?

11. Is this argument valid?

John is a friend of Joe.
Jerry is a friend of Joe. (no)
∴ Jerry is a friend of John.

12. Is this argument valid?

All fish are animals.
All guppies are fish. (yes)
∴ All guppies are animals.

Fill in the blank with what comes next:

13. 1, 3, 5, 7, ___(9)___

14. 1, 4, 9, 16, 25, ___(36)___

15. Eyes are to seeing as ears are to ___(hearing)___.

16. Jess, a dancer, said: "My niece does not call me Aunt Jess because I am her ___(Uncle Jess)___.

17. Doris, Edward, and Frank are a doctor, engineer, and firefighter.

    a. No person's name begins with the same first letter as the profession that person has.

    b. Edward is not the firefighter.

    Who has each profession?

    (Doris is the firefighter, Edward is the doctor, Frank is the engineer.)

GRADES 6, 7, 8

TO THE TEACHER

(PLEASE READ THIS!!!)

Many books on logic have been written for children (see bibliography). Especially well written are the Midwest Publications books by Anita Harnadek. Each of these books in itself could constitute several weeks or even months of teaching, discussion, and thinking. Most teachers do not have the time to fit all of these materials in their already full schedules along with everything else that must be taught. It is the purpose of this unit to cull from several of these sources the main points of logic along with some illustrative examples. In this way, many different aspects of logical thinking can be covered in a much shorter period of time. However, if more examples are desired, the sources mentioned are rich in material.

In addition, thinking exercises related to the "real world" have been included. Learning to think is useless unless students can apply these skills to everyday life. The lessons in this unit can prepare students to better solve the problems in their own lives

Several considerations should be kept in mind when teaching this unit. You, the teacher, are the most important part--the material is secondary. How you handle the class discussions, your enthusiasm, your warmth can make all the difference. The following points may help you to do a better job.

1. Read and study every lesson in this unit carefully before beginning to teach it. Some lessons take two or three readings before things begin to "sink in." Your students won't understand it if you don't!

2. Be sure to discuss all problems thoroughly in class. Never just assign them as written work to be handed in. Their thinking won't grow unless they can benefit from the thoughts of others.

3. Some of these examples may seem very simple. But the students must first understand the concepts in easy examples before they are ready to recognize similar reasoning in the real world.

4. Please recognize that students may come up with other answers which are also correct. Keep an open mind and listen to their reasons.

5. Start right now collecting articles, advertisements, and examples of logical and illogical reasoning. The world is full of them. Your students should also begin a collection. Day 18 will be devoted to their use. Some of the other lessons also include references to them.

6. In the "Problems" sections, you may choose many different methods of assignment. My suggestion would be to have the class try one or two and discuss their solutions together before going on. Doing them all at once may be overwhelming. Also the discussions will aid them in solving the rest.

7. Don't expect the students to write out all of their explanations for every problem. This practice could get very tedious! But be sure to tell them that they must be ready to defend their answers to the class.

8. There is probably more material here that you can possibly cover in twenty days. You will need to fit the lessons to the needs of your students and the time you have available. These lessons are planned for 45 or 50 minute periods. Use as much as time permits.

9. Except on the test, the answers are given immediately after the problem so the teacher can follow them easily in a discussion. Obviously, if you wish to use them for worksheets, the answers will have to be blocked out.

10. As often as possible, let the students decide where the reasoning is faulty, rather than telling them. Ask leading questions to stimulate their thinking.

Good luck and have fun teaching this! Be sure to fill out the questionnaire in the front of the book when you've finished.

DAY-TO-DAY SCHEDULE

Grades 6, 7, 8

LOGIC UNIT - 4 weeks - 45-50 minutes a day

Day 1: Pre-test and Unit Introduction

DEDUCTIVE

Day 2: Review of Logic Elimination Problems

Day 3: Create your own Logic Elimination Booklet

LOGIC

Day 4: Logic Symbols and "If-then" Sentences

Day 5: "Or" and "And" Sentences and Their Truth Values

Day 6: Double Negatives and Multiple $\sim$ Signs

Day 7: Necessary and Sufficient Conditions

Day 8: Truth Values of "If-then" Sentences

Day 9: Proposition, Converse, Inverse, and Contrapositive

Day 10: "Only if" Sentences and Their Truth Values

Day 11: Arguments, Syllogisms, Premises, and Conclusions

INDUCTIVE

Day 12: Inferences

Day 13: Analogies

Day 14: Cause and Effect

Day 15: Relevant Information

Day 16: Fallacies

Day 17: Open-Ended Problems

Day 18: Applications

Day 19: Unit Review

Day 20: Post-test

DAY 1 PRE-TEST AND INTRODUCTION TO UNIT

Objectives:
1. Students will show previous knowledge of logical thinking skills by taking the pre-test.
2. Students will be introduced to the study of logic through class discussion.

Directions: Administer the pre-test to the class with as little direction as possible. If they're not familiar with some of the terminology, have them try to understand it by reading the rest of the question. Give them as much time as possible to complete the test without feeling the pressure of time. When all have finished, collect the tests, score them and save the scores to compare with those on the post-test. Since the pre- and post-tests are the same, do not discuss any of the problems with the class. Tell them that the answers should become obvious as they proceed with the unit.

Unit Introduction

Ask the class for their definitions of logic and logical thinking. Ask what they think the purposes of studying logical thinking are. In the discussion, be sure the following points are brought out.

Persuasive messages come at us from our friends, from government, from all manner of sales strategies, from persons heatedly espousing public causes, even from persons with whom we engage in only casual discussion.

One purpose of a study of logic is to gain tools with which to distinguish good arguments from bad ones. Accordingly, logic may be regarded among the most powerful studies one can undertake.

Logic is the study of argument. Argument is a piece of reasoning in which one or more statements are offered as support for some other statement. Because the most outstanding characteristic feature of arguments is that they involve inferences, logic has been defined by some as the study of inference. (Inference is defined in Lesson 12.)

Deductive arguments are arguments in which the conclusion follows with necessity from the premises. (This will be further explained in Lesson 11.)

Example: All the pears in that basket are ripe.
All these pears are from that basket.
All these pears are therefore ripe.

Inductive arguments are those in which the conclusion is derivable from the premises only with probability.

Example: All these pears are from that basket.
All these pears are ripe.
All the pears in that basket are therefore ripe.

One difference between deductive and inductive arguments is that the premises in a deductive argument contain all the information needed in order to reach a conclusion that follows with necessity. In the conclusion of an inductive argument, we must venture beyond information contained in the premises. Thus our conclusion can never be certain, although it can have a high probability of being true. In inductive arguments, we assert in the conclusion a fact not itself contained in the premises.

Advantages of Logical Thought

It might well be thought that all one needs in order to guard against bad arguments is common sense. It does not always suffice. Practice in the study of argument provided by logic increases our ability to detect poor reasoning even in complex cases where common sense could not lead us to the heart of the error, in either our own or other people's reasoning.

Logic increases our sensitivity not only to structures that may mask poor reasoning but to the very language in which arguments are expressed. Words can conceal or distort as well as clarify. Arguments can try to persuade not by appeals to reason but by appeals to emotion and prejudice. By heightening our awareness of ways in which words can obscure and distort, logic helps us to free us both from confusion and from the designs such arguments have upon us.

By acquainting us with the conditions that must always be fulfilled in good reasoning, logic makes it easier for us to know when to withhold our assent and when we may safely offer it. Through learning the soft spots in our own and other people's reasoning, we become more exacting of ourselves and others.

(From Engels, With Good Reason)

LOGIC TEST

1. Read the following story and then mark each statement after the story either true (T), false (F), or questionable (?).

> Snow White's wicked stepmother hated her and wanted to dispose of her. The stepmother mixed a special potion and dipped an apple into this potion. She then disguised herself and tricked Snow White into taking a bite from the apple. As soon as she took a bite from the apple, Snow White fell to the floor, unconscious.

		T	F	?
(a)	The stepmother was glad that Snow White fell to the floor.			
(b)	Snow White fell to the floor as a result of taking a bite from the apple.			
(c)	Maybe Snow White deserved what she got.			
(d)	The stepmother was jealous of Snow White.			
(e)	The apple was poisoned.			
(f)	The stepmother tricked Snow White.			
(g)	Snow White didn't like her stepmother.			
(h)	Snow White died shortly after falling to the floor.			
(i)	We need a definition of "special potion" before we can draw any conclusions.			
(j)	The seven dwarfs got even for Snow White's death by killing the stepmother.			
(k)	Snow White was younger than her stepmother.			
(l)	We need to know more of the story before we can draw any conclusions.			
(m)	The stepmother disguised herself as an old woman selling apples.			
(n)	Snow White fell unconscious to the floor because her stepmother hated her.			
(o)	The stepmother was wicked.			

2. Roberto is a file clerk. His boss told him to file a paper yesterday, and Roberto filed it. His boss needed it again today, but when Roberto looked in the file it wasn't where he had put it. What is a reasonable inference for Roberto to make?

   (a) Roberto misfiled the paper.

   (b) He is not a good file clerk.

   (c) Someone took the paper from where Roberto filed it.

3. Marty got on an elevator at the first floor. He was the only one on the elevator. He pushed the button for the fifth floor. The elevator started up. He watched the indicator light and saw that the elevator was stopping at the third floor. What is a reasonable inference for Marty to make about why the elevator stopped at the third floor instead of at the fifth?

   (a) The elevator was broken.

   (b) Someone waiting on the third floor pushed the "up" button.

   (c) Marty pushed the wrong button.

4. Five people went on a picnic. All had stomach cramps later that day. Each person wrote down what he or she had eaten at the picnic.

   The first person had ham, pickles, lemonade, bread, mustard, potato salad, and pie.

   The second person had chicken, potato salad, cake, iced tea, pickles, bread, and deviled eggs.

   The third person had ham, bread, potato salad, mustard, lemonade, and deviled eggs.

   The fourth person had chicken, bread, pickles, pie, potato salad, iced tea, and ham.

   The fifth person had ham, pickles, iced tea, potato salad, mustard, pie, and cake.

   Some food they ate at the picnic caused their stomach cramps. What food do you think caused the cramps?

   (a) Potato salad

   (b) Bread

   (c) Pickles

5. Gloria was Betty's best friend until Melissa came along. A month after Betty met Melissa, however, Betty stopped spending time with Gloria and started spending all of her spare time with Melissa. Gloria was angry at Melissa for stealing her best friend. Gloria told Melissa she'd get even.

   A week later, Melissa's new cassette player was missing from her locker. It was found in Gloria's locker and had Gloria's fingerprints on it. Melissa remembered what Gloria had said about getting even with her. She accused Gloria of taking it.

   What do you think--did Gloria probably take it or not?

   _____ yes _____ no _____ ?

   Why do you think so?

Underline the correct answer to finish sentences 6-10.

6. Bed is to lie as chair is to — lay, set, sit, truth

7. Take is to took as bring is to — brang, brook, brought, brung

8. Tuna is to fish as iron is to — animal, metal, stone, vegetable

9. Wide is to width as long is to — altitude, breadth, height, length

10. Near is to purchase as ____ is to ____ — buy, by; by, buy; bye,bye; close, sell

11. Sam learned how to start a fire by rubbing two sticks together. He has noticed that the sticks always smoke before the fire starts. There is a fireplace in his house. Whenever he has started a fire in it, he has noticed that the logs always smoke before they catch fire. Does the smoke cause the fire?

12. Wilma has noticed that whenever it snows, it is very cold outside. Does snow cause cold weather?

13. Tom says that he does well on arithmetic tests if he doesn't study for them, but every time he studies for an arithmetic test, he doesn't do well on it. He says he's going to stop studying for any arithmetic tests so that he will do well on all of them. Do you think he's probably right?

14. Doreen has so many clothes that she wears a different outfit every day for three months. She is very popular and always has a bunch of kids hanging around her. Kitty does not have a lot of clothes and is not very popular. She decides she will earn some money and buy a lot of clothes so that she will be popular, too. Do you agree with Kitty's thinking?

15. Mr. Allen lives in an old frame house. A year ago he had his house insulated. Last winter the weather was about the same as the year before, and the summer has been about the same as the summer before his house was insulated. He has kept his thermostat at the same settings they were at before his house was insulated. His heating and air-conditioning bills have both gone down by about 35%. He figures his money was well spent. From what you are told, was Mr. Allen probably right?

16. Angelo, Becky, Conrad, and Doreen are an actor, a bellhop, a comedian, and a trapeze artist. From the clues below, match each person's name and occupation.

    1. Doreen is not in show business.
    2. Angelo is not the actor.

(a) Angelo, _____

(b) Becky, _____

(c) Conrad, _____

(d) Doreen, _____

17. From the statements which follow, find the first name, last name, and occupation of each person.

    1. Julie, Leon, and the firefighter had lunch together yesterday.
    2. Packard and the computer operator were ushers at a wedding.
    3. Kizzy and Monty told the toolmaker that she was conceited.
    4. The firefighter and the computer operator are engaged.
    5. Quill had her ears pierced last week.
    6. Julie thinks Smith has a boring job.
    7. Monty and the nurse are good friends.
    8. Richards likes her occupation but she thinks Julie's is safer.

	First Name	Last Name	Occupation
(a)	Julie	_____	_____
(b)	Leon	_____	_____
(c)	Kizzy	_____	_____
(d)	Monty	_____	_____

Tell whether the following are true or false. The "you" refers to you.

	T	F
18. If you are two feet tall, then you are very smart.		
19. If zebras have stripes, then grass is purple.		
20. If today is Thanksgiving, then you are in the third grade.		
21. You are cold if your hair is blue.		
22. If you are taking this test, then you are a student.		

Tell whether sentences 23-27 sound logical to you.

23. If a tiger is an animal and a tiger growls, then all animals growl.

    Yes _____ No _____

24. If a lily is a flower and a lily is white, then all flowers are white.

    Yes _____ No _____

25. If a cucumber is a vegetable and all vegetables are good for you, then cucumbers are good for you.

Yes _____ No _____

26. All three-sided figures are triangles.
This figure has three sides.
Therefore, it must be a triangle.

Yes _____ No _____

27. A square is a figure which has four sides.
This figure has four sides.
Thus, this figure is a square.

Yes _____ No _____

28. What does the statement, "I ain't got no pencil," mean?

(a) I don't have a pencil.

(b) I do have a pencil.

(c) I ain't got any pencil.

29. Ms. Young bought a new SUPER-8 car and gets an average of 15 km per liter of gasoline. She told Ms. Charov about it. Ms. Charov's car gets only about 9 km per liter of gasoline. Ms. Charov needs a new car, too. She'd like to get one which gets good gas mileage. She decides she'll get a new SUPER-8 of the same model Ms. Young bought and she'll even get it from the same car dealer. She figures that then she'll be sure of getting about the same gas mileage Ms. Young gets. What do you think? Is Ms. Charov right or not?

30. The teacher assigned homework last night which was due today. Camelia did not hand it in. The teacher asked her how come. Tell which of Camelia's statements are relevant to the teacher's question.

(a) I forgot and left it home. yes _____ no _____

(b) I had it when I left home this morning, but I didn't have it when I got to school. I must have dropped it on the way. yes _____ no _____

(c) I dropped it on the way to school. yes _____ no _____

(d) I watched television last night. yes _____ no _____

(e) I went with my parents to visit my grandparents last night. yes _____ no _____

(f) My mom and dad weren't feeling good yesterday, and I spent all my time taking care of them and my little brothers. yes _____ no _____

(g) I just finished it last night when my dog got hold of it and tore it up. yes _____ no _____

31. Royce wanted a pet dog. His parents said no. He asked again later. They said he'd have to give them some good reasons to have a dog before they'd let him have one. Tell which of Royce's statements are relevant to what his parents said.

    (a) All of my friends have dogs. yes _____ no _____

    (b) A lot of U.S. Presidents have had dogs. yes ___ no ___

    (c) I want a dog. yes _____ no _____

    (d) It will teach me responsibility. yes _____ no _____

    (e) It will keep me company. yes _____ no _____

    (f) It will protect me in case strangers come around. yes _____ no _____

    (g) It will give me something to show off to the other kids. yes _____ no _____

    (h) If I can't have a dog, then I'd like to have a cat. yes _____ no _____

    (i) Someone famous once said, "Every boy should have a dog." yes _____ no _____

32. Jake believes the statement, "The Surgeon General has determined that cigarette smoking is dangerous to your health." He also believes that the Surgeon General has never made a mistake in matters of health. If Jake is a very logical person, what will be his conclusion about this?

    (a) The Surgeon General has made a mistake this time.

    (b) Smoking is dangerous to your health.

    (c) We do not have enough evidence to draw a conclusion.

33. Suppose someone says to you, "Either you're crazy or I'm crazy," and you know that you're not crazy. What logical conclusion follows from this?

    (a) The other person is lying.

    (b) The other person is crazy.

    (c) The other person is either lying or crazy.

34. The queen told her beautiful victim, "I'll spare you only if you promise to marry my ugly son." The victim promised to marry the queen's ugly son, and the queen promptly killed her. Did the queen lie?

35. The ad said, "We can guarantee your satisfaction only if you send us your order before midnight tonight." Roosevelt sent in his order before midnight that same night. Has he been promised that they will guarantee his satisfaction? yes ____ no _____ Has he been promised that they can guarantee his satisfaction? yes ____ no ____

ANSWERS TO LOGIC TEST

1. (a) ? (Maybe the potion was supposed to make Snow White turn into a frog. If it didn't have this effect, the stepmother probably would not have been glad.)
   (b) ?
   (c) T ("Maybe Snow White didn't deserve what she got," is also true.)
   (d) ?
   (e) ?
   (f) T
   (g) ?
   (h) ?
   (i) F (We've already drawn some conslusions.)
   (j) ?
   (k) ?
   (l) F
   (m) ?
   (n) F (Only indirectly, the hate alone did not cause her to fall unconscious.)
   (o) T

2. (c) Someone took the paper from where Roberto filed it.

3. (b) Someone waiting on the third floor pushed the "up" button.

4. (a) Potato salad

5. ? We aren't told enough about Gloria to have any kind of reasonably concrete idea of what she meant by "getting even." She may have meant something like stealing the cassette player, or she may have meant something else like stealing one of Melissa's very good friends. We aren't told enough about the locker situtation. Did anyone else have access to Gloria's locker? If not, it's reasonable to assume that Gloria took the cassette player. But if so, then that person could have put the cassette player in Gloria's locker? Upon seeing it there, Gloria may well have picked it up to look at it more closely and then put it back, intending to try to check later to see whose it was and what it was doing in her locker.

6. sit

7. brought

8. metal

9. length

10. by, buy

11. No. The smoke is a result of heat. When the heat rises even further, fire results.

12. No. In a very broad sense, cold weather is a cause of snow, but snow does not cause cold weather.

13. Tom is thinking that his studying for some tests is the cause of his not doing well on them. Is it possible that the tests Tom doesn't study for are tests on material he understands thoroughly and has done a lot of practice problems for? Is it possible that the tests Tom studies for are tests on material he is confused about and hasn't done many practice problems for? Is it possible that if Tom stops studying for any arithmetic tests, he'll get worse grades than if he had studied for them?

14. No. What did Kitty seem to think was the reason for Doreen's popularity? Kitty apparently thought that Doreen's extensive wardrobe caused her to be popular, but popularity is usually the result of good personality, whether or not the person has nice clothes. Kitty was apparently confusing coincidence (or simultaneous events) with cause and effect.

15. Yes. An old uninsulated frame house easily loses heat in the winter and gains heat in the summer. Insulation helps the house maintain its temperature inside and its outside temperature outside. This is a good example of cause and effect.

16. (a) Angelo, comedian
    (b) Becky, trapeze artist
    (c) Conrad, actor
    (d) Doreen, bellhop

17. (a) Julie Quill, toolmaker
    (b) Leon Packard, nurse
    (c) Kizzy Richards, firefighter
    (d) Monty Smith, computer operator

If-then

18. T

19. F

20. T

21. T

22. T

Arguments

23. no

24. no

25. yes

26. yes

27. no

28. (b) I do have a pencil.

Analogies

29. Not enough information is given. Are their driving habits the same? (Or does Ms. Young drive moderately and steadily, while Ms. Charov uses jack-rabbit starts and is inconsistent on the gas pedal?) Are the places they drive comparable? (Or does Ms. Young do a lot of freeway driving, whereas Ms. Charov will be doing a lot of driving in stop-and-go traffic?) Are the distances they drive comparable? (or does Ms. Young drive her car for an average of, say, 16 kilometers at a time, whereas Ms. Charov will drive her car for an average of, say, only 1 kilometer at a time?) If such things are, in fact, comparable, then it is reasonable to suppose that Ms. Charov's gas mileage with her new SUPER-8 will compare favorable with Ms. Young's gas mileage.

Relevant Information

30. (a) Yes

    (b) Yes

    (c) No, unless she also explains why she didn't pick it up after she dropped it.

    (d) No. (Why didn't she do the homework before she left to visit her grandparents?)

30. (e) No
    (f) Yes
    (g) No. (Why didn't she redo it?)

31. (a) No
    (b) No
    (c) No. (They already know he wants a dog, so when they asked for good reasons, they implied that this was not one of them.)
    (d) Yes
    (e) Yes
    (f) Yes
    (g) No
    (h) No
    (i) No

32. (b) Smoking is dangerous to your health.

33. (c) The other person is either lying or crazy.

34. No

35. No, no

DEDUCTIVE

DAY 2 REVIEW OF LOGIC ELIMINATION PROBLEMS

Objectives:

1. Students will review the procedures for solving logic elimination problems.
2. Students will demonstrate knowledge of these procedures by solving several logic elimination problems.

Discussion: As a class, review together the method used to solve two-, three-, four-, and five-dimensional problems.

Examples:

1. Two-Dimensional Problems

The favorite sports of Brian, Horace, Ian, and Tammy are baseball, hiking, ice-skating, and tennis.

1. No person's name begins with the same letter as his or her favorite sport.
2. Tammy and Horace don't like team sports.
3. Horace and Brian don't like cold weather sports.

What is each person's favorite sport?

Step 1: Draw a chart like the following:

Names	baseball	hiking	ice-skating	tennis
B				
H				
I				
T				

Step 2: Put NO's in the appropriate boxes from Clue #1.

	baseball	hiking	ice-skating	tennis
B	1 NO			
H		1 NO		
I			1 NO	
T				1 NO

Step 3: Mark the appropriate boxes for Clue #2.

(a) Since Tammy and Horace don't like team sports, they cannot play baseball, so mark NO's in the boxes by their names under baseball.

(b) This leaves Ian as the baseball player, so mark an X by his name under baseball.

(c) Place NO's under hiking and tennis for Ian.

	baseball	hiking	ice-skating	tennis
B	1 NO			
H	2 NO	1 NO		
I	2 X	2 NO	1 NO	2 NO
T	2 NO			1 NO

Step 4: Mark the remaining boxes using Clue #3.

(a) Since Horace and Brian don't like cold weather sports, place NO's by their names under ice-skating.

(b) This leaves Tammy as the ice-skater. Place an X by her name in that column.

(c) Fill out the rest of Tammy's column with NO's.

(d) Brian is therefore left as the hiker, and Horace must be the tennis player.

The final chart will look like this:

	baseball	hiking	ice-skating	tennis
B	1 NO	3 X	3 NO	3 NO
H	2 NO	1 NO	3 NO	3 X
I	2 X	2 NO	1 NO	2 NO
T	2 NO	3 NO	3 X	1 NO

2. Three-Dimensional Problems

In this type of problem we make the chart so that each item in each list can be compared with each item in both other lists. Try this problem together:

Davis, Edwards, and Farman are an astronaut, a bookbinder, and a skin diver. Their ages are 25, 30, and 35. Match each person's name, job, and age.

1. Davis is younger than the astronaut but older than Farman.
2. The skindiver is younger than the bookbinder.

Step 1: Make a chart like the following:

	A	B	SD	25	30	35
D						
E						
F						
25						
30						
35						

Step 2: Using the information given in the two clues, mark the appropriate boxes. Instead of marking NO's, you may place the clue numbers in the NO boxes and the letters or numbers in the boxes which fill out the rows.

The final chart will look like this:

	A	B	SD	25	30	35
D	1	X	SD	25	X	D
E	X	E	F	25	30	X
F	1	F	X	X	F	F
25	A	25	X			
30	A	X	SD			
35	X	35	35			

Solution:

Davis, bookbinder, 30;
Edwards, astronaut, 35;
Farman, skin diver, 25.

3. Four- and Five-Dimensional Problems

Problems of four or more dimensions are solved the same way as the previous problems. Charts must be made comparing each list with all the other lists. As a group solve the following problem:

Davis, Edwards, and Gurley are the first, second, and third basemen for the Detroit Tigers. Their first names are Harold, José, and Ken. Their ages are 23, 25, and 28. From the clues below, match up everything.

1. The second baseman has a higher batting average than Ken or Davis.
2. The first baseman is younger than Edwards and older than Ken.
3. José and Davis ate pizza with some of the rest of the team after yesterday's game.

The final chart will look like this:

	D	E	G	1st	2nd	3rd	23	25	28
H	X	H	G	X	H	3rd	23	X	H
J	3	X	G	1st	X	3rd	23	25	X
K	1	2	X	2	1	X	X	2	2

1st	X	2	K
2nd	1	X	K
3rd	3rd	3rd	X

23	23	2	X	2	23	X
25	X	2	K	X	25	25
28	28	X	28	2	X	3rd

Solution:

Harold Davis, 1st baseman, 25;
José Edwards, 2nd baseman, 28;
Ken Gurley, 3rd baseman, 23.

Discuss the construction of a chart for a five-dimensional problem. Have the class decide how it should be made from the previous examples. They should develop one similar to the following:

	headings for second list	headings for third list	headings for fourth list	headings for fifth list
headings for first list	small boxes	small boxes	small boxes	small boxes
headings for third list	small boxes			
headings for fourth list	small boxes	small boxes		
headings for fifth list	small boxes	small boxes	small boxes	

Problems: Have the students solve the following problems independently and compare their answers. These problems may be given as homework and discussed the next day.

1. Art, Brad, Cindy, and Della each had their parents' permission to go to a certain after-school activity today. Find out where each person went (baseball practice, cheerleader tryouts, math club meeting, play rehearsal).

    1. Cindy did not go to baseball practice.
    2. Brad wanted to go to the cheerleader tryouts but decided to go to a different activity instead.
    3. The girl who went to the math club meeting told the club president that the meetings should not be held on the same day as so many other activities.
    4. The person who went to baseball practice was upset because she couldn't attend the play rehearsal.

    Solution: Art, cheerleader tryouts; Brad, play rehearsal; Cindy, math club meeting; Della, baseball practice.

2. Two girls (Francesca and Gretel) and two boys (Raoul and Tomio) specialize in different games (Backgammon, Chess, Monopoly, Scrabble). Their last names are Ishlan, Jones, Korning, and Loftis. Find each person's full name and game specialty.

    1. Jones, who does not play Monopoly, and Korning think they are better at their games than the girls are at theirs.
    2. The Backgammon player said she'd teach Loftis to play Chinese Checkers.
    3. Gretel and Ishlan had lunch with the Monopoly player.
    4. Raoul and the Chess player have the same locker in their physical education class at school.

    Use the following chart to solve this problem:

	I	J	K	L	B	C	M	S
F								
G								
R								
T								
B								
C								
M								
S								

Solution:

Francesca Ishlan, Backgammon;
Gretel Loftis, Scrabble;
Raoul Korning, Monopoly;
Tomio Jones, Chess.

3. Design your own chart for this problem.

Two girls (Victoria and Wanda) and two boys (Yuan-Tung and Zachariah) are working on science fair projects. Their last names are Almont, Bettcher, Corning, and Dowel. Their teachers are Elworth, Fletcher, Garner, and Ignash; and their ages are 9, 10, 11, and 12. One student is studying how the human heartbeat changes under different conditions. One is working on magic squares. One is going to enter a rock collection. One is studying how different amounts of sunlight affect the growth of plants. From the information below, match up everything.

1. Fletcher's student is 3/4 as old as Corning.
2. Almont uses a stethoscope for her project.
3. Zachariah is neither the oldest nor the youngest.
4. Wanda is a year older than the girl who is entering the rock collection.
5. Garner's student is not the one doing the sunlight study.
6. Bettcher thinks his project and the project of Ignash's student will both win first prizes.
7. Yuan-Tung is older than either Ignash's or Elworth's student.

Solution:

Victoria Dowel, rock collection, Fletcher, 9;
Wanda Almont, human heartbeat, Ignash, 10;
Yuan-Tung Corning, magic squares, Garner, 12;
Zachariah Bettcher, sunlight and plants, Elworth, 11.

Chart:

First Name	Last Name: A	B	C	D	Project: heart	MS	rock	sun	Teacher: E	F	G	I	Age: 9	10	11	12
V																
W																
Y																
Z																

Project	Last Name: A	B	C	D	Teacher: E	F	G	I	Age: 9	10	11	12
heart												
MS												
rock												
sun												

Teacher	Last Name: A	B	C	D	Age: 9	10	11	12
E								
F								
G								
I								

Age	Last Name: A	B	C	D
9				
10				
11				
12				

(Adapted from Mind Benders Instructions by Anita Harnadek)

DAY 3 LOGIC ELIMINATION BOOKLET

Objectives:

1. Students will continue to analyze the structure of logic elimination problems.
2. Students will synthesize previous learning by creating a class booklet of original logic elimination problems.
3. Students will evaluate their own and other students' problems and make recommendations.

Discussion: If possible, show the class the booklet "Synapse" by Thinking Caps (See Bibliography). Discuss the components of logic elimination problems: 1) Title; 2) Story (including the main points); 3) Clues. Each of the clues must give a portion of the solution without revealing too much. Go over several examples with the class to see how the clues are written.

Assignment: Have each member of the class write his or her own logic problem using the components discussed.

Be sure the students try out their own problems first to see if they need any changing.

At least two classmates should proofread each problem and make suggestions for improvement if necessary.

The authors may choose to illustrate their own problems if time allows or one or more class artists may volunteer to do the illustrating.

Combine all problems into a class booklet including the answers. Enough booklets may be printed for each class member. Extra booklets might be sold for a money maker.

This project could obviously take more than one day. It could be continued as an out-of-class project if interest exists.

DAY 4 LOGIC SYMBOLS

Objectives:

1. Students will gain understanding of the use of "if-then" sentences.
2. Students will gain understanding of the use of logic symbols, -- $\longrightarrow$, the capital block letter, and $\sim$.
3. Students will demonstrate their understanding by analyzing several examples.
4. Students will create new problems using the skills gained.

Discussion: "If-then" sentences

1. When two possibilities are related so that if one occurs, the other will also occur, it is called an "if-then" sentence.

   "If Aaron leaves right now, then Bert will give him a ride home."

   "If-then" sentences are used so much in the study of logic that we use the symbol "$\longrightarrow$ " in place of the words "if" and "then." "$\longrightarrow$ " = implies.

2. We also use a capital block letter in place of all the words needed for a simple complete thought. We might use the letter "A" for "Aaron leaves right now" and the letter "B" for "Bert will give him a ride home." Using the notation, we could write the above sentence A $\longrightarrow$ B. It can then be read "A implies B" or "If A, then B." It is important to understand that you cannot read A $\longrightarrow$ B as Aaron implies Bert. A and B must stand for a simple complete thought. In any one problem, the same letter(s) cannot be used for different thoughts.

   You may wish to use more than one capital block letter to express a thought. For example:

   "If the animal is a tiger, then it has big claws" could be written "AT $\longrightarrow$ ABC."
   AT = the animal is a tiger, and ABC = the animal has big claws.

   How would you write the following sentences using capital block letters and the $\longrightarrow$ sign?

   (a) If we have rain, then we have clouds.
   (R $\longrightarrow$ C)

(b) If Art dissects a frog, then he is very nervous. (AD $\longrightarrow$ AN or something similar)

(c) If Rosemary goes outside, whe has to wear sunglasses. (RGO $\longrightarrow$ RS)

The word "if" must appear in an "if-then" sentence. (Sometimes "when," "whenever," or "provided that" can be substituted for "if.") The word "then" may appear or it may be taken for granted. Here are some more "if-then" sentences. How would you write them in symbolized form?

(d) Yoshiko laughs if she hears a joke. (YJ $\longrightarrow$ YL)

(e) Susan shivers whenever she's cold. (SC $\longrightarrow$ SS)

(f) Provide that Esther gets an A on a test, she is happy. (EA $\longrightarrow$ EH)

Because we want to be consistent in the study of logic, we always write "if-then" sentences as "A $\longrightarrow$ B" -- that is, "If A, then B."

3. The "$\sim$" sign.

We use "$\sim$" to mean "not" or "it is false that" or "it is not the case that."

If we want to say, "If Elvira doesn't leave right now, Pedro will give her a ride home." We can put E = Elvira leaves right now, and P = Pedro will give Elvira a ride home. Then we can write, "If $\sim$E, then P," or "$\sim$E $\longrightarrow$ P." We could read this as "If not E, then P," or "If E is false, then P."

If we want to write, "Either that animal has big claws, or it's not a tiger," we can write it "ABC or $\sim$AT." The word "either" was left out of the sentence because it isn't really needed. The sentence means exactly the same thing with or without the word "either" in it. We can read it as "ABC or not AT."

One more way to use the "$\sim$" sign is shown in this example:

> "It is not true that if Aaron leaves right now, then Bert will give him a ride home," can be written " (A $\longrightarrow$ B)." It would then be read, "It is not true that A $\longrightarrow$ B," or "It is false that A $\longrightarrow$ B."

Problems: Write the following "if-then" sentences using symbolic language.

1. If Ernie goes, then Eva will go. (ER $\longrightarrow$ EV or something similar; not E $\longrightarrow$ E)

For problems 2-7, use the following symbols:

D = dinosaurs exist

I = invisible horses are polka-dotted

E = elephants have wings

2. If dinosaurs exist, then invisible horses are polka-dotted. (Don't worry if this doesn't make sense to you -- D $\longrightarrow$ I)
3. If it is false that invisible horses are polka-dotted, then dinosaurs don't exist. ($\sim$I $\longrightarrow$ $\sim$D)
4. It is false that if invisible horses are polka-dotted, then dinosaurs don't exist. ($\sim$(I $\longrightarrow$ $\sim$D))
5. If elephants have wings or dinosaurs exist, then invisible horses are polka-dotted. ((E or D) $\longrightarrow$ I)
6. If it is false that elephants don't have wings, then dinosaurs exist. ($\sim\sim$E $\longrightarrow$ D; E $\longrightarrow$ D is also acceptable)
7. Either dinosaurs don't exist, or elephants don't have wings. But if elephants don't have wings, then invisible horses are not polka-dotted. However, invisible horses are polka-dotted. So dinosaurs don't exist. ($\sim$D or $\sim$E
$\sim$E $\longrightarrow$ $\sim$I
I
So $\sim$D)

Problems 8-10:

Using the following symbols, make up three of your own "if-then" sentences. Share them with the class.

L = Miss Leary is a good teacher

S = the students like Miss Leary's class

E = everyone learns a lot

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

DAY 5 "OR" AND "AND" SENTENCES AND THEIR TRUTH VALUES

Objectives:

1. Students will gain understanding of the meaning and use of "or" sentences.
2. Students will gain understanding of "and" sentences.
3. Students will analyze the truth values of "or" and "and" sentences.

Discussion:

1. An "or" sentence is a sentence which gives us a choice of two thoughts. Here are some examples:
   (a) Either today is the 4th of July or today is Christmas Day.
   (b) Either you have three arms or you don't have three arms.
   (c) Most teenagers like hamburger or pizza.
2. An "and" sentence is a sentence which has two thoughts connected by the word "and." Examples:
   (a) Today is the 4th of July and today is Christmas Day.
   (b) You have three arms and you don't have three arms.
   (c) Most teenagers like hamburger and pizza.
3. The truth value of an "and" or "or" sentence tells us whether the sentence is true or false.

   For each of the following sentences, write the truth value (T or F) in the column marked TV. Then mark the truth value of the first part of the sentence (the A part) in the A column and the truth value of the second part (the B part) in the B column.

	TV	A	B
1. Either today is the 4th of July or today is Christmas Day.			
2. The word "respect" means "hold in high regard" or "think highly of."			
3. Either you have three arms or you don't have three arms.			

	TV	A	B
4. Either you don't have five legs or you have five legs.			
5. Either you are a human being or you are a machine made of plastic.			
6. Most teenagers like hamburgers or pizza.			
7. You weigh 900 kilograms or you are 287 years old.			
8. Either George Washington was born before Columbus, or Marco Polo was an explorer.			
9. Either you're a boy or you're a girl.			
10. Either you have purple hair or you have orange eyes.			

(Answers are obvious)

Complete the following sentence based upon your chart above. The sentence "A or B" is false if and only if _____.
(Answer: A and B are both false)

In the next group of sentences, first write the truth value of each (T or F) in the TV column, then write the truth value of A in the A column and the truth value of B in the B column.

	TV	A	B
11. Today is the 4th of July and today is Christmas Day.			
12. The word "respect" means "hold in high regard" and "think highly of."			
13. You have three arms and you don't have three arms.			
14. You don't have five legs and you have five legs.			
15. You are a human being and you are a machine made of plastic.			
16. Most teenagers like hamburger and pizza.			

	TV	A	B
17. You weigh 900 kilograms and you are 287 years old.			
18. George Washington was born before Columbus, and Marco Polo was an explorer.			
19. You're a boy and you're a girl.			
20. You have purple hair and you have orange eyes.			

(The A and B columns should be the same in 1-10 and 11-20)

Complete this statement using the chart above. The sentence "A and B" is true if and only if _____.

(Answer: A and B are both true)

Using the substitutions shown below, rewrite each sentence in symbolized form.

A = all ads are exaggerated

S = some products work the way their ads say they will

1. All ads are exaggerated, and it is false that some products work the way their ads say they will. (A and $\sim$S)
2. It is false that all ads are exaggerated, and some products work the way their ads say they will. ($\sim$A and S)
3. Some ads are not exaggerated, and some products work the way their ads say they will. ($\sim$A and S)
4. If all ads are exaggerated, then it is false that some products work the way their ads say they will. (A $\rightarrow$ $\sim$S)
5. Some ads are not exaggerated, and no product works the way its ad says it will. ($\sim$A and $\sim$S)

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

DAY 6 DOUBLE NEGATIVES

Objectives:

1. Students will demonstrate understanding of double negatives and their meanings through discussion.
2. Students will apply the concept that a double negative is positive in everyday speech and advertising.

Discussion: What does this statement mean to you? "It's false that I'm not going." What is a simpler way of saying this sentence? (I am going.) The person making the statement used a "double negative" which made the sentence more difficult to understand. If I = I am going, the statement would look like this "$\sim\sim$I" in symbolized form. But as we stated earlier, it would be much simpler just to say "I." Therefore, two consecutive "$\sim$" signs cancel each other.

Write these examples in symbolized form:

(a) It's false that the sky is not clear. ($\sim\sim$C)
The sky is clear. (C) ($\sim\sim$C = C)

(b) It isn't true that this isn't good. ($\sim\sim$G)
This is good. (G) ($\sim\sim$G = G)

It is always safe to cancel double negatives using "it is false that" or it isn't true that." Sometimes, though, a statement may appear to be the negation of (or the "$\sim$" of) another statement when it actually is not the negation.

Statement: I like him.
Negation: I don't like him.
Not Negation: I dislike him.

Because you don't like someone, doesn't mean you dislike him or her. You may never have heard of the person so you neither like nor dislike him. In the same way, bad is not the negation of good. Something may be good, bad or somewhere in between.

Problems: Simplify each of the following statements using words. If the statement is already simplified, write "simplified."

1. It is false that it isn't raining now. (It is raining now)
2. It is false that I dislike him. (Simplified)
3. It is false that I don't like him. (I like him)

4. Either it is false that I don't like red cars, or I don't like green cars. (Either I like red cars, or I don't like green cars)

5. If it's false that I'm not going, then I won't stay home. (If I'm going, then I won't stay home)

6. It's false that if I'm not going, then I won't stay home. (Simplified)

7. It isn't true that it's false that I don't like him. (I don't like him)

8. It isn't true that it's false that it's not the case that I don't like him. (I like him)

9. Phyllis didn't bring no pencil today. (Phyllis brought a pencil today)

10. Phyllis didn't bring any pencil today. (Simplified)

11-20. For each of the above sentences, write the symbolized form using A for the first part of the sentence and B for the second part. If the sentence needed to be simplified, write both forms. (Hint: Whenever you see "$\sim\sim$", they cancel each other.)

11. $\sim\sim A$; A

12. $\sim A$

13. $\sim\sim A$; A

14. $\sim\sim A$ or $\sim B$; A or $\sim B$

15. $\sim\sim A \longrightarrow \sim B$; $A \longrightarrow \sim B$

16. $\sim (\sim A \longrightarrow \sim B)$

17. $\sim\sim\sim A$; $\sim A$

18. $\sim\sim\sim\sim A$; A

19. $\sim\sim A$; A

20. $\sim A$

Make a list of double negatives used by your classmates and others you hear on radio, TV, and other places. How many can you find before our next meeting? Be ready to share your list with the class and tell what the person should have said. Examples:

1. I ain't got no paper. (I have some paper)

2. "Wendys--ain't no reason to go anyplace else." (Wendys--there is reason to go anyplace else)

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

DAY 7 NECESSARY AND SUFFICIENT CONDITIONS

Objectives:

1. Students will gain understanding of necessary and sufficient conditions through class discussion and examples.
2. Students will apply the knowledge gained to specific examples.
3. Students will find and analyze examples from newspapers, magazines, and other media for necessary and sufficient condition.

Discussion:

1. Sufficient condition - If one condition is enough to cause, or to guarantee another condition, then the first is a sufficient condition for the second. Examples:

   (a) If there is rain, then there are clouds.

   (b) If she is an attorney, then she is a college graduate.

   (c) If Spot is a dog, then he is an animal.

   In each example, the first condition is sufficient for the second (but not necessary for it). Now look at the three examples again. In each case, the second condition is necessary for the first -- that is, we cannot have the first without the second.

2. Necessary condition - If one condition cannot exist without a second condition, then the second is a necessary condition for the first.

   Therefore, as you can see in the examples above, if the first condition is a sufficient condition for the second, then the second condition is a necessary condition for the first. Be sure you understand that the two ideas are not the same.

   (d) Rain is not a necessary condition for clouds.

   (e) Being an attorney is not a necessary condition for being a college graduate.

   (f) Being a dog is not a necessary condition for being an animal.

3. Equivalent statements - Equivalent statements are two or more statements which have the same truth values under all conditions. They can be freely exchanged for each other.

(a) We must have clouds in order to have rain.

(b) We have clouds whenever we have rain.

(c) There are clouds if there is rain.

(d) Rain is a sufficient condition for clouds.

(e) Clouds are a necessary condition for rain.

These are also equivalent statements:

(f) If A, then B.

(g) A $\longrightarrow$ B.

(h) B if A.

(i) A is a sufficient condition for B.

(j) B is a necessary condition for A.

What other examples of necessary and sufficient conditions can you think of? How many equivalent statements can you think of for them?

Problems: Tell which is the necessary and which is the sufficient condition for each of the following. Rewrite each statement as an "if-then" sentence.

1. A pencil is a writing instrument.
2. A computer is a machine.
3. All firefighters are brave.
4. A college professor is an intelligent person.
5. A triangle has at least three sides.
6. A chair is a piece of furniture.
7. All hamburgers are made of beef.
8. A friend is always loyal.
9. Every tree is a plant.
10. All fire is hot.

Assignment: Find examples from literature, conversation, or the media which exemplify necessary and sufficient conditions. Be able to point out to the class which part is which.

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

Teacher center

DAY 8 TRUTH VALUES OF "IF-THEN" SENTENCES

Objectives:

1. Students will be able to analyze the truth values of various "if-then" sentences.
2. Students will apply knowledge of truth values to several life-like situations.

Discussion: If someone points to a triangle and makes the following statement: "If this is a triangle, then it has four sides," what is the truth value of the sentence? (Obviously false.) Which parts of it are true and which are false? (A is true and B is false.) Therefore, A $\longrightarrow$ B is false when A is true and B is false.

We will find that an "if-then" sentence is false if and only if A is true and B is false. How would you fill in the rest of this sentence to make it true?

If this is a triangle, then _____.

The only way the statement can be true is if we put in a true statement -- "it has three sides." Therefore, A $\longrightarrow$ B is true if A and B are both true.

However, what if A is false? What is the truth value then? Remember that A $\longrightarrow$ B is a guarantee. The person who makes that guarantee is either telling the truth or he isn't. If someone says, "if it rains tomorrow, then I'm not going fishing," we don't know for sure what he'll do if it doesn't rain. Whether he goes fishing or not, he hasn't lied to us, so we assume he has told us the truth. Therefore, A $\longrightarrow$ B is true if A is false. (Use more examples if everyone does not understand.)

If we put all of this information together in chart form, it makes it easier to remember.

If A is	and if B is	then A $\longrightarrow$ B is
T	T	T
T	F	F
F	T	T
F	F	T

By looking at the chart, you can see that the sentence "A $\longrightarrow$ B" is false if and only if A is true and B is false.

Problems: Tell the truth value of each sentence below (T or F). Assume that "you" means you. Remember that A is the "if" part and B is the "then" part.

1. If today is the 4th of July, then you have green hair. (T)

2. If today is not the 4th of July, then you have green hair. (F)

3. If today is the 4th of July, then you don't have green hair. (T)

4. If today is not the 4th of July, then you don't have green hair.

5. If you are 500 years old, then you are in the 3rd grade. (T)

6. You're not very wise if you're only 5 years old. (T)

7. All trees have brown bark if some women are doctors. (F)

8. The SUPER-8 is the best car on the market if there are no other cars on the market. (T)

9. Invisible horses are polka-dotted provided that live elephants have wings. (T)

10. You're open-minded when you're thinking critically. (T)

Problems 11-20. Tell the truth value of the underlined parts of each sentence. Do not use your knowledge of the world; accept each sentence as true. (Go over some of these together to be sure they understand.)

11. If all triangles have four sides, then all circles are lopsided. Not all circles are lopsided. (F)

12. If some old coins are valuable, then they are worth more than their face values. Some old coins are valuable. (T)

13. If Mr. Keller is an engineer, then Mrs. Keller is a firefighter. Mrs. Keller is a firefighter. (?)

14. All turtles are small if whales are mammals. All turtles are small. (?)

15. All turtles are small if whales are mammals. Not all turtles are small. (F)

16. All turtles are small if whales are mammals. Whales are mammals. (T)

17. If Canada is a large country, then Canadians are friendly. Canada is a large country. (T)

18. If Mr. Wilson is wealthy, then Mrs. Wilson is the president of the company. Mr. Wilson is not wealthy. (?)

19. If you like hamburgers, then you like hotdogs. If you like hotdogs, then you like sandwiches. You like hamburgers. (T, T)

20. If you like hamburgers, then you like hotdogs. If you like hotdogs, then you like sandwiches. You don't like sandwiches. (F, F)

Problems 21-27. Answer the questions asked.

21. The plumber told Mr. Welson, "If I don't fix that leak, then I won't send you a bill." The plumber worked on it for five hours but couldn't fix the leak because the plumbing was in too much of a mess and needed major repairs first. But Mr. Welson didn't want to have the major repairs done because he was planning to sell the house soon. The plumber figured that it wasn't his fault that he didn't fix the leak, so he billed Mr. Welson for five hours of work. Did the plumber lie to Mr. Welson? (Yes)

22. Diana read the ad: "If you use SUPERLASH, your eyes will be more beautiful." Diana used a different product, and her eyes were more beautiful. Did the ad lie to Diana? (No)

23. Flora read the same ad as Diana. Flora already had beautiful eyes, and she used SUPERLASH, but her eyes didn't get any more beautiful. Did the ad lie to Flora? (Yes)

24. Mr. MacIntyre read the ad: "If you want a cleaner house, then you'll use ULTRACLEAN." Mr. MacIntyre wanted a cleaner house, but he never did use ULTRACLEAN. Did the ad lie to Mr. MacIntyre? (Yes)

25. Steve, a resident of Windsor, Ontario, was visiting his friend, Rex, who lived in Detroit, Michigan. Steve read an ad Rex found in a newspaper: "If you're a resident of Michigan, then you're eligible to enter. Do it NOW!" Rex didn't enter the contest, but Steve entered the contest and put his own address on the entry blank, and his entry was accepted. Did the ad lie to Steve? (No) Did the ad lie to Rex? (No)

26. The teacher told Emma, "If you don't do these extra credit problems, then you won't get an A on this report card." Emma did all of the extra credit problems and did them correctly, but she still didn't get the A on that report card. Did the teacher lie to Emma? (No)

27. Mr. Wong told his wife, "If I stop at the store on the way home from work, I'll be about an hour late." He was about an hour late getting home from work, but he didn't stop at the store on the way. Did he lie to his wife? (No)

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

DAY 9 PROPOSITION, CONVERSE, INVERSE AND CONTRAPOSITIVE

Objectives:

1. Students will be able to recognize the difference between the four forms of the proposition.
2. Students will demonstrate this knowledge by analyzing several examples.
3. Students will be able to detect faulty reasoning and give reasons why it is faulty.

Discussion: Any sentence which can be written in "if-then" ($A \longrightarrow B$) form is called a proposition.

Every proposition has a converse, an inverse, and a contrapositive. But these three cannot exist on their own without the proposition.

The converse of the proposition $A \longrightarrow B$ is $B \longrightarrow A$

The inverse of the proposition $A \longrightarrow B$ is $\sim A \longrightarrow \sim B$

The contrapositive of the proposition $A \longrightarrow B$ is $\sim B \longrightarrow \sim A$

Give some sentences which show each type of sentence. For instance:

Proposition:	If it is a tree, then it is a plant.
Converse:	If it is a plant, then it is a tree.
Inverse:	If it is not a tree, then it is not a plant.
Contrapositive:	If it is not a plant, then it is not a tree.

(Write several examples on the board.)

As you can see from these examples, the proposition and its contrapositive are equivalent statements. (They mean the same thing.)

You can also see that the converse and the inverse are equivalent statements.

Are the proposition and its converse equivalent statements? (No)

Are the proposition and its inverse equivalent statements? (No)

The converse or inverse of a proposition may be either true or false. A proposition may be true without having a true converse. One of the most common mistakes in reasoning is the substitution of the converse or the inverse of a proposition for the proposition.

Problems: Give the converse, inverse, and contrapositive for each proposition.

1. If we have rain, then we have clouds. (Converse - If we have clouds, then we have rain; Inverse - If we don't have rain, then we don't have clouds; Contrapositive - If we don't have clouds, then we don't have rain.)
2. If you leave right now, then you'll get there on time. (See above)
3. If you won't pay attention, then you won't understand this.
4. If this is Monday, then you're crazy.
5. If you want fantastic results, then you'll use SUPERGREAT.
6. If you don't learn this, then you're not trying hard enough.
7. If this is Sunday, then I'll eat my hat.
8. If you wear nice clothes to school, then your teachers will be impressed.
9. If you leave now, then I will take you home.
10. If you get an A on the test, then you understand the material.

Problems 11-15. We have learned that it is faulty reasoning if we substitute the converse or the inverse of a proposition for the proposition. Tell whether or not the person in the problem was guilty of faulty reasoning. If he was, then tell what was wrong with his reasoning.

11. Mr. Wong told his wife, "If I stop at the store on the way home from work, I'll be about an hour late." That afternoon, Mrs. Wong realized that her husband was 55 minutes overdue from work, and she thought, "He must have stopped at the store on his way home." (faulty, substituting converse)
12. The teacher told Emma, "If you don't do these extra credit problems, then you won't get an A on this report card." Emma did all of the extra credit problems because she wanted an A, and she was sure the teacher had promised her an A if she did the problems. (faulty, inverse)

Teacher Center

13. Doreen had a date that night, but her mother told her, "If you don't apologize to your brother for the way you treated him, then you're not going out tonight." Doreen didn't want to break her date, so she apologized to her brother for the way she treated him, but her mother still made her stay home. Doreen told her mother that they'd made a bargain and that Doreen had kept her end of it but her mother had broken the bargain. (faulty, inverse)

14. Mr. Chu had lived under Communist rule in China but had managed to escape to the United States. He knew that a communist ruler always made sure that the country had socialized medicine, so when he heard that the U.S. President was in favor of socialized medicine, he was sure that the President was a communist. (faulty, converse)

15. Mrs. Smother read the ad: "If you don't try our product, then you'll be sorry." She didn't want to be sorry, so she tried the product. She didn't like the product, however, and she was sorry she'd tried it. She wrote to the president of the company and complained that the advertising for the product was misleading. (faulty, inverse)

Assignment: Bring at least one example to the next class of faulty reasoning by substituting the converse or inverse of the proposition.

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

Teacher center

DAY 10 "ONLY IF" SENTENCES AND THEIR TRUTH VALUES

Objectives:

1. Students will be able to recognize an "only if" sentence and its truth value.
2. Students will analyze hypothetical situations to determine their truth values.

Discussion: An "only if" statement is an "if-then" statement in which "then" is replaced by "only if." The form is "A only if B." Examples:

1. I'll do my homework tonight only if you explain it first.
2. I'll go hiking tomorrow only if I feel better by then.
3. You are eligible for this contest only if you're a resident of Iowa.
4. You can see an invisible tiger only if you have unusually good eyesight.
5. You can go out tonight only if you apologize to your brother first.

What these sentences are saying is, "The only way we'll have A is to have B." Therefore, B is a necessary condition for A, which is another way of saying "$A \longrightarrow B$." So "A only if B" is the same as "$A \longrightarrow B$."

Thus, we have learned that all of the following are equivalent statements:

1. A only if B.
2. If A, then B.
3. B if A
4. $A \longrightarrow B$
5. $\sim B \longrightarrow \sim A$
6. A is a sufficient condition for B
7. B is a necessary condition for A

Problems: Problems 1-5. Put the following sentences in the form of "if-then" sentences. (Answers - the contrapositives are also acceptable.)

1. I'll do my homework tonight only if you explain it first. (If I'll do my homework tonight, then you'll explain it first.)

Teacher eater

2. I'll go hiking tomorrow only if I feel better by then. (If I'll go hiking tomorrow, then I'll feel better by then.)

3. You are eligible for this contest only if you're a resident of Iowa. (If you are eligible for this contest, then you're a resident of Iowa.)

4. You can see an invisible tiger only if you have unusually good eyesight. (If you can see an invisible tiger, then you have unusually good eyesight.)

5. You can go out tonight only if you apologize to your brother first. (If you can go out tonight, then you can apologize to your brother first.)

Problems 6-10. Put these sentences in "only if" form.

6. If we have rain, then we have clouds. (We have rain only if we have clouds.)

7. Elvira laughs if she hears a joke. (Elvira hears a joke only if she laughs.)

8. Susan shivers whenever she's cold. (Susan is cold only if she shivers.)

9. Whenever it's Saturday, Al is glad. (It's Saturday only if Al is glad.)

10. Nat cries when he sees a sad movie. (Nat sees a sad movie only if he cries.)

Problems 11-15. Answer the questions in the following problems.

11. The contest advertisement stated, "You are eligible for this contest only if you're a resident of Kentucky."

    (a) Roberto was a resident of Wyoming, but he entered the contest anyhow, and his entry was accepted. Did the ad lie to Roberto? (Yes)

    (b) Chi-Hai was a resident of Kentucky, but he was visiting Taipei for three months when he read the ad. He sent in his entry from Taipei and his entry was accepted. Did the ad lie to Chi-Hai? (No)

    (c) Cleo was a resident of Kentucky. She sent in her entry, but it was rejected. Did the ad lie to Cleo? (No)

12. Brett's father told him, "You can use the car tonight only if you wash it first." Brett washed the car but his father still wouldn't let him use it. Brett was angry and he said his father lied to him, but his father said he didn't lie. Who was right? Support your answer. (Brett's father was right. Brett is guilty of substituting the converse of a proposition for the proposition.)

13. Flora had a lovely voice, and Mr. Rowly, the vocal music teacher, kept asking Flora to drop her study hall and sign up for the choir. Flora finally told him, "I'll drop my study hall and sign up for the choir next Tuesday only if you don't bug me about it anymore in the meantime." Mr. Rowly agreed not to say anything more to her about it in the meantime. Well, the following Tuesday came and went, and Flora had not even tried to drop her study hall and sign up for the choir. Mr. Rowly told Flora that she broke her word, and Flora said she didn't. Who was right? Support your answer. (Flora was right. Mr. Rowly is substituting a converse for its proposition.)

14. Barry, Hisashi, and Fernandel all read the ad which said, "You'll like this product only if you're hard to please. Your money back if this ad hasn't told you the truth."

    (a) Barry was hard to please. He tried the product but didn't like it, so he wanted his money back. Was he entitled to a refund? Why? (No. Barry thinks the ad says "H $\longrightarrow$ L," so he is substituting a converse for its proposition.)

    (b) Hisashi wasn't hard to please. He tried the product and didn't like it. Was he entitled to a refund? Why? (No. In Hisashi's case, we have that L is false, so the ad told Hisashi the truth. We aren't told whether or not Hisashi thought he had a refund coming, so we can't say whether or not Hisashi's thinking was faulty.)

    (c) Fernandel wasn't hard to please. He tried the product and liked it. Was he entitled to a refund? Why? (Yes. In Fernandel's case, we have a true L and a false H, so the ad lied to him.)

Teacher Center

15. Harriet's mother was going to visit some relatives for the weekend and wanted Harriet to go with her. Harriet didn't want to go, and she tried to talk her mother into letting her stay home alone. Her mother said, "I've had about enough of this nonsense from you! The only way you're not going with me is if you can talk your grandmother into letting you stay with her." Harriet thought that staying with her grandmother was a lot better than going to visit those other relatives, so she talked her grandmother into letting her stay there. Harriet's mother made Harriet go with her to visit the other relatives anyhow. Did Harriet's mother mislead Harriet? Support your answer. (No. If Harriet thought her mother's statement was misleading, Harriet was substituting a converse for its proposition.)

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

DAY 11 ARGUMENTS, SYLLOGISMS, PREMISES AND CONCLUSIONS

Objectives:

1. Students will be able to distinguish between premises and conclusions given several arguments and syllogisms.
2. Students will be able to determine logical and illogical conclusions by analyzing the premises.
3. Students will create their own syllogisms in small groups.
4. Students will evaluate the arguments of classmates for logical thinking.

Discussion: An argument is an "if-then" sentence where the premises are the "if" part and the conclusion is the "then" part. Examples:

(a) If all flowers are pretty and a rose is a flower, then a rose is pretty.

Premise: All flowers are pretty.
Premise: A rose is a flower.
Conclusion: A rose must be pretty.

(b) If a rhinoceros is an animal and if no animal is a vegetable, then a rhinoceros is not a vegetable.

Premise: A rhinoceros is an animal.
Premise: No animal is a vegetable.
Conclusion: Therefore, a rhinoceros is not a vegetable.

Another word which is sometimes used for this type of argument is a "syllogism." Syllogisms have three statements. The first two are the premises and the third is the conclusion. A syllogism must contain 3 and only 3 terms (flowers, pretty, rose; rhinoceros, animal, vegetable) and they must have the same definition throughout.

In the examples above, the conclusions were logical. But not everyone thinks logically, so some arguments may have illogical conclusions. Example:

(c) Most birds can fly, and a robin is a bird, so a robin must be able to fly.

This conclusion is not logical. The first premise says that most (not all) birds can fly. The second premise does not tell us whether a robin is one of the majority or an exception, so the conclusion does not follow from the premises. Here's another example:

(d) All triangles have three sides, so a zebra must have stripes.

This conclusion is also not logical. Here, the conclusion has nothing to do with the premise.

Some arguments do not use the words "if" and "then." Words which can be substituted for "if" include "when," "whenever," "provided that," "since," "because," "in view of the fact that," and "for." Words which can be substituted for "then" include "hence," "so," "therefore," "thus," "consequently," "it follows that," and "only if."

Activity: See how many syllogisms or arguments the class can think of using this knowledge of premises and conclusions. You may want to break into small groups and then have exchange arguments checking to see whether the conclusions are logical or illogical.

Problems: Tell whether each argument is logical or illogical.

1. All human beings are mortal. Yvette is a human being. So Yvette is mortal. (logical)
2. All lilacs are pretty. All lilacs are flowers. Then all flowers are pretty. (illogical)
3. All lilacs are pretty. All lilacs are flowers. Thus, some flowers are pretty. (logical)
4. If Mrs. Hernandez is an attorney, then she is a college graduate. Mrs. Hernandez is an attorney. Therefore, Mrs. Hernandez is a college graduate. (logical)
5. Roses are red. Violets are blue. Hence, sugar is sweet, and I love you. (illogical)
6. Mrs. Rosa doesn't like cats, and no housewife likes cats. Hence, Mrs. Rosa is a housewife. (illogical)
7. My dog doesn't like cats, and no mouse likes cats. So my dog is a mouse. (illogical)

Problems 8-14. Each problem can be made into an argument. Tell which parts are the premises and which part is the conclusion.

8. José must really be smart (1), because he gets all A's (2), and he takes hard classes (3). (C, P, P)
9. I know you're wrong (1), because my brother said so (2). (C, P)

10. If an eight-footed elephant exists, then it must have wings (1). But anything which has wings can fly (2). So, if an eight-footed elephant exists, then it can fly (3). (P, P, C)

11. Miss Downey told me that's right (1), so I know it's right (2), because Miss Downey never lies (3). (P, C, P)

12. A crow is black (1) and a raven is black (2). Then all birds must be black (3), since both crows and ravens are birds (4). (P, P, C, P)

13. If you believe that (1), then you must be pretty dumb (2), because that's obviously false (3). (P, C, P)

14. Miss Blonding is too good a teacher to give us a test when we're not ready for it (1), and we're not ready for a test on this (2), so Miss Blonding won't give us a test on it yet (3). (P, P, C)

15. Is it possible to have a logical conclusion in an argument if the conclusion is false? Give an example.

Assignment: Try problems 1-7 out on your parents or brothers and sisters. See how many they can get right.

(Adapted from Critical Thinking, Book 1 by Anita Harnadek)

INDUCTIVE

DAY 12 INFERENCES

Objectives:

1. Students will be able to make sound inferences from the premises presented to them.
2. Students will be able to defend their inferences using logical thinking.

Discussion: In Lesson 11, you learned that premises and conclusions are necessary in order to have an argument. The act of passing from premises to conclusion is known as inference. In logic, inferences are never merely guesses. They are instances of reasoning and as such may be either good or bad reasoning.

You infer something when you judge, conclude, surmise, gather, or think that something is true. You infer (or make an inference) about something you read, hear, see, feel, taste, or touch.

People are sometimes heard to say, "That may be logical, but it's not true," or "What's logical isn't always right." Both of these views are correct, yet they do not mean that logic is unconcerned with truth.

Validity refers to the correctness with which a conclusion has been inferred from its premises.

Truth refers to whether those premises and conclusion accord with the facts. It is possible in logic to start with true premises but reach a false conclusion (because we reason badly with those premises) or to reason correctly or validly without reaching a true conclusion (because our premises are false).

Soundness results when the premises of an argument are true and its conclusion validly derived from them.

In order to accept the conclusion of an argument as true, we must be sure of two things:

1. that the premises are true
2. that the inference from the premises is valid, not invalid.

(From Engels, With Good Reason)

Examples:

1. Jim said, "Hi, Mary!" Mary sneered and stuck out her tongue at him. Jim inferred that Mary was mad at him for something. (Jim seems to have made a good inference.)
2. Jan saw a sign at the beach, SHARKS NO SWIMMING. She inferred that sharks were not allowed to swim there. (Jane has made a poor inference.)

Problems: Write your answers for Problem #1 and then discuss them together with the class. Were your inferences correct?

In the first two problems, a story is given followed by some statements. Decide whether each statement is true (T), false (F), or questionable (?).

In deciding on each statement, you must follow these rules:

(a) You must accept the story as true.

(b) You may not use any past knowledge of the story.

(c) You must assume the story used good English.

Mark your own answers first and then discuss them with the class. Be prepared to defend your answers.

1. Jack and Jill went up the hill to fetch a pail of water. Jack fell down and broke his crown, and Jill came tumbling after.

	T	F	?
(a) Jack and Jill were the only two people who went up the hill.			
(b) All people who go up hills fall down.			
(c) Jack and Jill took a pail with them.			
(d) Jack and Jill walked up the hill.			
(e) Since Jill "came tumbling," Jill must have been fat.			

		T	F	?
(f)	If Jack and Jill were the only people near the hill during the story, then Jack fell first, and Jill fell second.			
(g)	The water spilled as a result of their falling.			
(h)	Jack was angry at Jill.			
(i)	Because they went up the hill, they fell down.			
(j)	There was water obtainable at the top of the hill.			

Answers:

(a) ? (Maybe there were others, but the story just didn't mention them.)

(b) ? (Probably false, but I've never known anyone who hasn't fallen down.)

(c) ? (Maybe the pail of water was waiting for them at the top.)

(d) ?

(e) F (Jill didn't have to be fat in order to tumble.)

(f) ? (Maybe Jill tripped and fell and then Jack tripped over her and fell and started Jill tumbling.)

(g) ? (Maybe they didn't get the water.)

(h) ?

(i) F (not the direct cause)

(j) ?

2. Little Miss Muffet sat on a tuffet eating her curds and whey, when along came a spider and sat down beside her and frightened Miss Muffet away.

	T	F	?
(a) Miss Muffet's parents couldn't have loved her very much, or they would not have given her curds and whey to eat.			
(b) Miss Muffet was frightened by the spider.			
(c) Miss Muffet had already started to eat when the spider came along.			
(d) Miss Muffet was watching TV when the spider came along.			
(e) No spider can sit down.			
(f) Maybe Miss Muffet liked curds and whey.			
(g) Assuming that a well-balanced meal must include a dairy product, meat, a fruit or vegetable, and a cereal product, we know that Miss Muffet was not in the process of eating a well-balanced meal when the spider came along.			
(h) Miss Muffet was sitting down while she was eating her curds and whey.			
(i) Maybe Miss Muffet wasn't frightened at all. Maybe she just didn't want to finish her curds and whey, so she only acted frightened, but she wasn't really frightened.			
(j) The spider had been invited to lunch by Miss Muffet.			
(k) Miss Muffet didn't finish eating.			
(l) Miss Muffet moved away from the spider.			
(m) The spider liked curds and whey.			

Answers:

(a) F (They could have loved her but had nothing else to give her.) ? if they reason that they don't know whether Miss Muffet's parents were living.

(b) T

(c) T

(d) ?

(e) F (If we must accept the story as true, maybe he was the only spider in the world who could sit down.)

(f) T

(g) F (We don't know this.)

(h) T

(i) F (We must accept the story as true.)

(j) ?

(k) ? (Maybe she took her food with her or came back for it later.)

(l) T (if we must accept the story as true) F is the spider moved with her.

(m) ?

3. Yesterday Dan's hair was bright red. Today it is dark brown. What can you reasonably infer from this? (He probably died it or had dye removed from it.)

4. Brett is nine years old. He reads all the stories he can find about firefighters. He watches all the TV programs about firefighters. His best friend's father and mother are both firefighters. Brett wants to be a firefighter when he grows up. Is it reasonable to infer that Brett will be a firefighter when he grows up? How come? (No. Children often idolize people who have daring jobs and think they want such a job when they get old enough. As most get older, however, their interests broaden and they decide to enter some other occupation. It is not reasonable, though, to infer that he will not become a firefighter either.)

5. The TV ad said, "For whiter teeth, fresher breath, a brighter smile, a more attractive you, use ULTRA-SMILE--the super toothpaste!"

   Portia wanted whiter teeth (and so on) than she was getting from the toothpaste she was using. She believed the ad, so she switched to ULTRA-SMILE.

   Suppose the ad was truthful.

   (a) What did Portia seem to think that the ad had said? (She thought that the ad said she would have whiter teeth (and so on) if she used ULTRA-SMILE than if she stuck with her present brand of toothpaste.)

   (b) Do you think Portia's inference was correct? How come? (No. The ad didn't say whiter teeth than what, and so on. Portia inferred that the ad meant whiter teeth (and so on) than she would have using her present toothpaste, but the ad might merely have meant whiter teeth (and so on) than she would have if she didn't brush her teeth at all (in which case we would have to admit that the ad would be quite truthful).)

6. Raoul sees a man walking down the street. As the man walks, coins seem to be falling from the leg of his pants. What is a reasonable inference for Raoul to make? (The pocket where the man carries change has a hole in it.)

7. Ms. Darby found out that she is allergic to tomatoes. Every time she eats something with tomatoes in it, she breaks out in a rash. Tell whether or not it is OK for her to eat the following foods.

   (a) catsup (No)

   (b) mustard (Yes)

   (c) apple pie (Yes)

   (d) chili (Probably not since most chili has tomatoes in it.)

   (e) spaghetti and sauce (Spaghetti, yes; the sauce, no.)

   (f) vegetable soup (Yes, if it doesn't have tomatoes in it; otherwise, no.)

   (g) hamburgers (Yes, if she doesn't put catsup on them.)

   (h) macaroni and cheese (Same as (f) above.)

Teacher Center

8. The teacher has given the class several spelling tests. Shawn has done poorly on every one of them. Shawn always says he knows how to spell the words, but "got nervous" or "forgot" or "couldn't concentrate" or "wasn't feeling well." The teacher has sometimes given Shawn the same test later, and Shawn has still done poorly on it. What do you think the teacher should infer about Shawn's spelling ability? (We know that his spelling performance is low so far, but we aren't given enough information to infer anything accurate about his spelling ability. Maybe he has a lot of ability but just doesn't use it. Maybe he's just too lazy to study the word lists. Maybe he has no place to study. Maybe he has so many duties at home he has no time to study. Maybe he needs glasses. Maybe he has a hearing problem.)

9. Jill is in high school. She is taking courses in typing and shorthand. Is it reasonable to infer that Jill is planning to be a secretary or a stenographer? How come? (No. Typing and shorthand are practical courses for anyone planning to go to college. Maybe Jill is farsighted enough to realize this and is taking the courses to make her college work easier.)

10. Mr. Kenly applies for a job as a salesperson for an office machine company. When he goes for the interview, he wears jeans and a shirt which is unbuttoned to the waist. His hair is scraggly. He chews gum with his mouth open. He slumps in his chair. When asked if he minded working long hours, he says, "No, that don't bother me none."

    The job requires the salesperson to take office machines to offices to show prospective customers how the machines work and how the machines work and how the machines can help them in their businesses. The person who is interviewing Mr. Kenly can tell that Mr. Kenly knows a lot about office machines.

    Do you think Mr. Kenly will probably get the job? How come? (No. A job applicant is supposed to look and act his best. If this is Kenly's best, what would he be like after he was on the job for a while? Also, the job Kenly is applying

for requires someone to represent the company to outsiders. His poor grammar, along with his undesirable appearance, would give outsiders a poor impression of the company and they would be unlikely to buy the machines.)

(Adapted from Critical Thinking and With Good Reason)

DAY 13 ANALOGIES

Objectives:

1. Students will show understanding of reasoning by analogy by filling in increasing difficult analogies.
2. Students will show skills of analysis and synthesis by completing analogies using their own words.
3. Students will evaluate analogies used in life-like situations as to their merits.

Discussion: An analogy compares two things to each other. Sometimes we compare the way two things are related to each other to two other things which are similarly related. For example:

(a) Able is to unable as can is to cannot.

(b) Active is to inactive as alive is to dead.

In these two examples, the second and fourth words are opposites of the first and third. Therefore, we say that the two sets of words are analogous. How are the following sets of words related to each other?

(c) ask, why; answer, because (You say why when you ask and because when you answer.)

(d) fleas, dog; lice, human (Fleas are pests found on dogs and lice are pests found on humans.)

(e) quarter, 1/4; half, 1/2 (Another way to say the same thing.)

See if you can fill in the fourth word in the following examples. The choices are on the right.

(f)	down, up; basement, _____.	eyes
(g)	go in, go out; enter, _____.	fall
(h)	laugh, cry; mouth, _____.	fresh
(i)	old, new; stale, _____.	leave
(j)	up, down; rise, _____.	roof

What is the thinking process you used to determine the answers? (Figure out the relationship of the first two words and apply it to the second two.)

Now consider the following analogy:

In real life, the TV repairman refers to diagrams while repairing a set. The drafter refers to manuals while drawing. The engineer and the architect refer to blueprints while building. The attorney refers to law books and notes while trying a case.

It follows that it's stupid not to let students in school use their books and notes while they're taking a test. I mean, school is supposed to prepare students for everyday life, right? And I just showed you that people in everyday life use their books and notes while they're doing their jobs, which is like being tested, right? So it follows that students in school should be allowed to use their books and notes while they're taking tests, too.

(a) What is the main idea of this analogy? (That students in school should be allowed to use their books and notes while taking tests.)

(b) What two things does the analogy compare? (Using reference materials while on the job is compared with using books and notes while taking a test.)

(c) In what ways does the problem state or imply that the two things are alike? (Reference materials are like books and notes. Being on the job is like taking a test. A worker on the job is like a student.)

(d) Do you think the analogy is good, so-so, or poor? How come? (The first comparison is false: the reference materials cited are details about specific jobs being done, not about the basic knowledge needed for those jobs, whereas a student's books and notes are for basic knowledge which the workers on the job already have, and for which they do not use reference materials. The second comparison is questionable: although it may be true in the case of a new worker, it is not true (unless we say it is true only in an extremely broad sense) for an old hand who has proved his or her worth. The third comparison is false in the sense the speaker uses it here. After an initial training period, the worker has all the basic knowledge necessary to do the job. But a student is (supposed to be) acquiring new basic knowledge. The analogy is a poor one.)

As you can see, some analogies are good ones, and some are not. To decide whether or not an analogy is good, you think about the ways in which the two things are alike. Then you ask yourself whether or not these similarities (likenesses) are enough to make the conclusion reasonable.

Problems:

Problems 1-5. Fill in the blank with the word that logically completes the analogy from the column on the right.

1. (a) honest, dishonest; right, _____. after
   (b) hot, cold; steam, _____. good
   (c) slow, fast; snail, _____. horse
   (d) sooner, later; before, _____. ice
   (e) wrong, right; bad, _____. wrong

   (wrong; ice; horse; after; good)

2. (a) agree, disagree; yes, _____. needy
   (b) east, west; sunrise, _____. no
   (c) high, low; mountain, _____. open
   (d) rich, poor; wealthy, _____. sunset
   (e) seal, unseal; close, _____. valley

   (no; sunset; valley; needy; open)

3. (a) affirmative, negative; yes, _____. low
   (b) brawny, scrawny; strong, _____. no
   (c) elevated, depressed; high, _____. play
   (d) occupation, recreation; work, _____. slow
   (e) rapid, gradual; fast, _____. weak

   (no; weak; low; play; slow)

4. (a) distance up, height; distance down, _____. little
   (b) healthy, well; sick, _____. passing
   (c) illegal, unlawful; legal, _____. depth
   (d) large, great; small, _____. ill
   (e) permanent, lasting; temporary, _____. lawful

   (depth; ill; lawful; little; passing)

5. (a) behind, after; ahead, _____. before
   (b) high, tall; low, _____. disembark
   (c) less, smaller; more, _____. greater
   (d) sail, embark; land, _____. heavy
   (e) trivial, light; weighty, _____. short

   (before; short; greater; disembark; heavy)

Problems 6-10. Fill in blanks 3 and 4 from the words found in the two columns on the right.

6. (a) common, familiar; _____, _____.
   (b) covered, closed; _____, _____.
   (c) incense, anger; _____, _____.
   (d) mature, ripe; _____, _____.
   (e) now, immediately; _____, _____.

3rd blank	4th blank
delight	green
immature	later
then	open
uncommon	please
uncovered	strange

(uncommon, strange; uncovered, open; delight, please; immature, green; then, later)

7. (a) bottle, bag; _____, _____.
   (b) MacDonalds, Colonel Sanders; _____, _____.
   (c) mashed potatoes, gravy; _____, _____.
   (d) sugar, butter; _____, _____.
   (e) thin, thick; _____, _____.

3rd blank	4th blank
french fries	catsup
hamburger	flour
milk	fried chicken
soup	oleo
saccharin	stew

(milk, flour; hamburger, fried chicken; french fries, catsup; saccharin, oleo; soup, stew)

		3rd blank	4th blank
8.	(a) bed, lie; _____, _____.	chair	seedling
	(b) lay, laid; _____, _____.	lie	lie
	(c) lie, lay; _____, _____.	set	seedling
	(d) plant, seed; _____, _____.	set	set
	(e) put, recline; _____, _____.	sit	sit

(chair, sit; lie, lay; sit, set; set, seedling; set, lie)

		3rd blank	4th blank
9.	(a) minuend, remainder; _____, _____.	add	add
	(b) minus, plus; _____, _____.	divide	divide
	(c) quotient, product; _____, _____.	multiply	divide
	(d) sum, difference; _____, _____.	subtract	multiply
	(e) times, into; _____, _____.	subtract	subtract

(subtract, divide; subtract, add; divide, multiply; add, subtract; multiply, divide)

		3rd blank	4th blank
10.	(a) arm, elbow; _____, _____.	ankle	knee
	(b) elbow, finger; _____, _____.	foot	toe
	(c) finger, hand; _____, _____.	knee	foot
	(d) hand, arm; _____, _____.	leg	leg
	(e) wrist, finger; _____, _____.	toe	toe

(leg, knee; knee, toe; toe, foot; foot, leg; ankle, toe)

Problems 11-15. These problems are like the previous problems, except that the 3rd blank is already filled in, and you have to make up your own words for the 4th blank.

		(Possible Answers)
11.	(a) approve, clap; disapprove, _____.	(boo)
	(b) gray, light black; tan, _____.	(light brown)
	(c) this, that; here, _____.	(there)
	(d) this, these; that, _____.	(those)
	(e) whisper, hospital; shout, _____.	(football stadium)

		(Possible Answers)
12.	(a) approve, flower; disapprove, _____.	(weed)
	(b) cat, meow; dog, _____.	(bark)
	(c) thank you, taker; you're welcome, _____.	(giver)
	(d) weight, kilograms; age, _____.	(years)
	(e) whimper, cry; giggle, _____.	(laugh)
13.	(a) golf, club; baseball, _____.	(bat)
	(b) paw, claw; hand, _____.	(fingernail)
	(c) present, past; are, _____.	(were)
	(d) screw, screwdriver; nail, _____.	(hammer)
	(e) wrench, plumber; saw, _____.	(carpenter)
14.	(a) area code, zip code; telephone, _____.	(mail)
	(b) bird, fly; fish, _____.	(swim)
	(c) now, immediately; after while, _____.	(later)
	(d) opthalomologist, eyes; dentist, _____.	(teeth)
	(e) paintings, museum; books, _____.	(library)
15.	(a) add, plus; subtract, _____.	(minus)
	(b) ascend, rise; descend, _____.	(fall)
	(c) summer, warm; fall, _____.	(cool)
	(d) year, sun; month, _____.	(moon)
	(e) zoo, cage; jail, _____.	(cell)

Problems 16-20. These problems are like the first problems, except that you have to make up your own third and fourth blanks.

		(Possible Answers)
16.	(a) dawn, start; _____, _____.	(sunset, end)
	(b) front end, back end; _____, _____.	(first, last)
	(c) refrigerator, cold; _____, _____.	(oven, hot)
	(d) should, must; _____, _____.	(ought to, has to)
	(e) tree, forest; _____, _____.	(individual, group)

(Possible Answers)

17. (a) astronaut, cosmonaut; _____, _____. (U.S., Russia)
    (b) fire, ice; _____, _____. (hot, cold)
    (c) kitten, pup; _____, _____. (cat, dog)
    (d) sun, day; _____, _____. (moon, night)
    (e) valley, low; _____, _____. (mountain, high)

18. (a) lemon, sour; _____, _____. (candy, sweet)
    (b) lemon, yellow; _____, _____. (lime, green)
    (c) mother, maternal; _____, _____. (father, paternal)
    (d) rise, up; _____, _____. (fall, down)
    (e) tiger, snarl; _____, _____. (dog, growl)

19. (a) badminton, shuttlecock; _____, _____. (tennis, ball)
    (b) baseball, bat; _____, _____. (golf, club)
    (c) fact, fiction; _____, _____. (real life, fairy tale)
    (d) football, field; _____, _____. (baseball, diamond)
    (e) this, that; _____, _____. (these, those)

20. (a) coffee, bean; _____, _____. (tea, leaf)
    (b) cup, cocoa; _____, _____. (glass, milk)
    (c) hare, tortoise; _____, _____. (fast, slow)
    (d) hear, ears; _____, _____. (see, eyes)
    (e) tall, high; _____, _____. (short, low)

Problems 21-25. These problems are like the previous problems, except only the first blank is filled in. Fill in the second, third, and fourth blanks with words chosen from the columns on the right.

	2nd blank	3rd blank	4th blank
21. (a) lipstick, _____, _____, _____.	hand	coronary	ear
(b) palm, _____, _____, _____.	head	dentures	eyes
(c) pulmonary, _____; _____, _____.	lungs	hear	foot

	2nd blank	3rd blank	4th blank
(d) taste, _____, _____, _____.	mouth	mascara	heart
(e) wig, _____; _____, _____.	tongue	sole	mouth

(mouth, mascara, eyes; hand, sole, foot; lungs, coronary, heart; tongue, hear, ear; head, dentures, mouth)

22.				
(a) cereal, _____; _____, _____.	breakfast	cup	coffee
(b) civilian, _____; _____, _____.	drink	dressing	eat
(c) glass, _____; _____, _____.	meal	food	lunch
(d) gravy, _____; _____, _____.	potatoes	military	mess
(e) liquid, _____; _____, _____.	water	sandwich	salad

(breakfast, sandwich, lunch; meal, military, mess; water, cup, coffee; potatoes, drassing, salad; drink, food, eat)

23.				
(a) abacus, _____; _____, _____.	flicker	computer	automatic
(b) dawn, _____; _____, _____.	manual	disk	evening
(c) light, _____; _____, _____.	morning	racket	fry
(d) music, _____; _____, _____.	pleasant	skillet	twinkle
(e) oven, _____; _____, _____.	roast	star	unpleasant

(manual, computer, automatic; morning, dusk, evening; flicker, star, twinkle; pleasant, racket, unpleasant; roast, skillet, fry)

	2nd blank	3rd blank	4th blank
24. (a) accurate, _____; _____, _____.	approve	hoot	approximate
(b) clap, _____; _____, _____.	gradual	inaccurate	disapprove
(c) clothing, _____; _____, _____.	necessity	jewelry	erosion
(d) possible, _____; _____, _____.	precise	landslide	is likely
(e) sudden, _____; _____, _____.	probable	may be	luxury

(precise, inaccurate, approximate; approve, hoot, disapprove; necessity, jewelry, luxury; probable, may be, is likely; gradual, landslide, erosion)

	2nd blank	3rd blank	4th blank
25. (a) attorney, _____; _____, _____.	church	dentist	medicine
(b) entomologist, _____; _____, _____.	eyes	numismatist	coins
(c) minister, _____; _____, _____.	insects	nurse	synagogue
(d) optometrist, _____; _____, _____.	law	physician	teeth
(e) teacher, _____; _____, _____.	school	rabbi	hospital

(law, physician, medicine; insects, numismatist, coins; church, rabbi, synagogue; eyes, dentist, teeth; school, nurse, hospital)

26. Brad watched a TV ad for CLEAR, a face soap. The ad showed suds from CLEAR being rubbed on one photograph and suds from Brad's brand of face soap being rubbed on another photograph. Both photos were then held under running water. The photo rubbed with CLEAR suds rinsed so that it was clear. But the other photo still had a film of soap on it.

Brad said he was going to switch to CLEAR because he didn't like the idea of having a film of soap left on his face.

(a) What analogy did Brad use? (He assumed there is a similarity between (1) the surfaces of a photo and human skin and (2) the way soap clings to (or rinses from) a photograph and human skin.)

(b) Do you think this analogy was a good one? How come? (No, it is doubtful that the surfaces of a photo and human skin are similar and that there is a connection between the way soap reacts on a photo and the way it reacts on human skin. Even if there is a similarity, were the photos in the ad identical, or had one been treated with something before the commercial?)

27. Glamis Clamorous, the movie queen, is advertising DAZZLING, a new toothpaste, on TV. She says, "My teeth have to look their best for those close camera shots. But I don't have to worry about it anymore.. Now I use DAZZLE, and just look how white my teeth are!" The camera moves in for a close-up, and she says, "Give your teeth a chance to look as white as mine. Use DAZZLE!"

(a) What is the main idea? (You should try using DAZZLE toothpaste.)

(b) What two things does the analogy compare? (The way Glamis' teeth look after using DAZZLE is compared with the way your teeth can look after using DAZZLE.)

(c) In what ways does the problem state or imply the two things are alike? (They are alike in looking white.)

(d) Do you think the analogy given is good, so-so, or poor? How come? (Poor. As anyone who has had a front tooth filled or replaced knows, teeth vary in color from very white to a pale yellow. Brushing the teeth with a particular (nonstaining) product may remove stains, but it will not change the natural color of the teeth. To make them snow-white like Glamis' teeth, the brusher would have to have naturally snow-white teeth, in which case just about any toothpaste will do the job.)

(Adapted from Reasoning By Analogy, Analogies C, and Analogies D by Anita Harnadek)

DAY 14 CAUSE AND EFFECT

Objectives:

1. Students will be able to recognize examples of cause and effect.
2. Students will be able to distinguish between events which have a cause and reflect relationship and events which do not.
3. Students will recognize cases in which cause is mistaken for effect and effect is mistaken for cause.

Discussion: People often think that when two events happen almost simultaneously, they must somehow be related. This kind of thinking often results in falsely concluding that one of the events must be the cause (or the effect) of the other. Example:

1. "I had a bad cold, so I stayed in bed for a week, and the cold got better. Therefore, staying in bed will cure a cold."

A second way people err in their reasoning is in mistaking an effect for a cause or a cause for an effect. Example:

2. "Every city which has crime has a police force. So if we'd get rid of our police forces, we'd abolish crime."

We should also be aware of three other forms of false cause as well as the first two mentioned:

3. Mistaking coincidence for cause and effect.

   "I walked under a ladder, and five minutes later I almost got hit by a car. So walking under a ladder causes bad luck."

4. Mistaking sequential events for cause and effect.

   "I heard tires screeching. I looked up and two cars hit each other. So screeching tires cause car accidents."

5. Mistaking related events for cause and effect.

   "I saw Canada geese flying northward. Within a week, my daffodils bloomed. Therefore, the geese caused the daffodils to bloom."

Consider the following example:

Tonya lives in South Dakota. She has noticed that whenever the clock says the time is 11:00 P.M., it is very dark outside. She thinks that her clock causes the darkness. How might someone show her that she is wrong? (Change the time the clock shows and it will still be dark out.)

Problems: Read the following examples and tell whether they are examples of cause and effect or false cause.

1. Someone noticed that people who go to college are usually more intelligent than people who don't go to college. The person who noticed this said that if we'd make sure that everyone goes to college, then everyone would be intelligent. What do you think of this? (The person is confusing one of the effects of being intelligent with a cause of being intelligent. That is, a person who is intelligent is more likely to go to college than a person who isn't, but going to college will not cause one to be intelligent.)

2. Dave and Sandy were walking to school together. Sandy said, "We'd better hurry. It looks like it's going to start pouring rain any minute!" Dave said, "Don't say that, or it will!" Just then, a downpour started. Dave and Sandy both got soaked. Dave said, "See? If you hadn't said anything, the rain would probably have held off until we got to school." What cause-and-effect relationship did Dave seem to believe? Do you agree with this belief? How come? (Dave apparently believed that saying it would rain any minute caused the rain to start sooner than it would have started if nothing had been said. No. Words do not influence weather. This is a case of mistaking sequential events for cause and effect.)

3. Ms. Lawten has noticed that hard-working people live in clean houses, while lazy people live in dirty houses. She says that if the government would provide everyone with a clean house then no one would be lazy. Do you agree? Explain. (No. A clean house is a result of hard work, not a cause of it. And a dirty house is sometimes a result of laziness, not a cause of it.)

4. Mr. Bardfor has just been elected to the school board. He knows that students who get poor marks do not learn as much as students who get good marks. He thinks that all students should be given good marks. He says that this will make sure that the students learn more. What do you think of this idea? (Mr. Bardfor is mistaking cause for effect and vice versa. While it may be true that nothing breeds success like success, it also appears to be true that the recent nationwide trend of inflating grades has done nothing except that a student who now gets A's in some schools would have been a B or C student in that school some years ago.)

5. Larry lives in Iowa. He doesn't like school. He has to go to school in the fall and winter and spring when the weather is cold to warm. But in the summer when its warm all the time, there is no school. He knows it's always warm in southern Texas. He wants his parents to move there so that he'll never have to go to school. What do you think of his reasoning? (Larry is confusing related or simultaneous events with cause and effect.)

6. Many years ago, farmers noticed that their fresh milk nearly always turned sour either during or shortly after a thunderstorm. They concluded that thunder caused milk to turn sour. What do you think of their reasoning? (They were confusing related or simultaneous events with cause and effect. Thunderstorms usually happen in hot weather, and the bacteria in fresh milk multiply rapidly in heat, causing the milk to sour.)

7. Some children do not eat breakfast before going to school. Many people believe that these children misbehave more and learn less than children who do eat breakfast. These people think that a child's misbehavior and lack of learning is one effect of the child's hunger. They say that each school should provide breakfast for children who do not eat breakfast at home. That way, they say, no child will be thinking about how hungry he or she is at school instead of thinking about what is being taught. Do you think these poeple are right, or not? How come? (Be sure your students discuss the cause (hunger) and effect (misbehavior, lack of learning) relationship assumed by the proponents of the proposal. You might like to ask these questions too: (1) Is it possible that some children who do eat breakfast also misbehave and don't learn in school? (2) Is it possible that some children who don't eat breakfast don't misbehave and do learn in school? (3) Suppose that the great majority of kids who don't eat breakfast do act up in school, and the great majority of kids who eat breakfast don't act up in school. Would this prove that eating or not eating affects the behavior of the majority of kids? (Is it possible that they'd act the same way even if they switched from eating to not eating, or from not eating to eating, breakfast?).)

8. Jimmy's house is on a corner. There is a stop sign there. Each time a car approaches the corner, Jimmy whispers, "Stop!" and the car stops. Then Jimmy whispers, "Get going!" and the car starts going again. Jimmy feels very powerful, since he knows he can control cars just by telling them what to do. What, if anything is wrong with Jimmy's reasoning? (Jimmy is mistaking sequential events or coincidence for cause and effect.)

9. Ross lives in Wisconsin. He had noticed that every year the weather gets warmer as soon as a robin is seen in his neighborhood. And as soon as no more robins are seen, the weather turns cold. He wants to catch a robin and keep it so the weather will be warm all year. What do you think of this idea? (Ross is mistaking cause for effect. That is, the robin's returning is a result (or effect) of warmer weather, not a cause of it.)

10. Scott is better than other kids at almost everything. He's the best in the school at all sports. He gets straight A's in his classes. He's good-looking. He dresses well. He is an expert artist and musician.

    But the other kids don't like him much. Scott thinks the reason is that they are jealous of him. But he figures that if they can't accept that some people are better at things than other people, then that's just tough rocks.

    (a) What does Scott think is the cause of his unpopularity? (He thinks the other kids' jealousy of him causes them to dislike him.)

    (b) What does Scott think is the cause of the cause of his unpopularity? (He thinks the other kids' jealousy is caused by his being better at things than they are.)

    (c) Suppose Scott is right (from "a" and "b" above). What is he willing to do to get rid of these causes? (Nothing)

    (d) Suppose Scott is wrong. What do you think might cause his unpopularity? (Be sure your students stick with the "suppose." That is, don't accept an answer such as, "Maybe he is an unfriendly person. Maybe he's conceited about all of his accomplishments. Maybe he puts the other kids down for being inept at what he's so good at.")

(Adapted from Cause and Effect by Anita Harnadek)

DAY 15 RELEVANT INFORMATION

Objectives:

1. Students will be able to analyze the difference between relevant and irrelevant statements through class discussion and practice problems.
2. Students will evaluate irrelevant statements found in campaign speeches, television programs, newspapers, and magazines and from other people.

Discussion: Ask the class what they think relevant means, list their definitions on the board. (Relevant can mean "having to do with," "connected with," "applying to," "applicable to," or "bearing upon." Ask if anyone knows the opposite of relevant (irrelevant). Examples:

(a) Mary is feeling ill. She is going to the doctor later. When the doctor asks why she is there, it will be relevant if Mary tells him about the stomach cramps she's been having. It will be irrelevant if she tells him that she likes her new car.

(b) Ms. Brown wants to be our mayor. The degree of her honesty is relevant to the question of whether or not she would be a good mayor. The number of children she has is not relevant to this question. The color of her hair is irrelevant.

(c) The Morton's are trying to decide where to spend their vacation this year. They have two children. Tell which of their questions are relevant to the problem:

1. How much will this place cost? (Yes if their money is limited; no if cost doesn't matter.)
2. How long will it take to get there? (It depends. If the vacation is for only a week and it takes three days each way for travel, the question is relevant. But if it takes only two to four hours to get there and the Morton's are trying to decide whether it's two hours or four hours, then the question is not relevant.)
3. Shall we invite the Grant's over for dinner tomorrow? (No)
4. How far away is it? (No)

5. Will the kids like it? (Yes if the kids are going with them. No if they're not.)
6. There are a lot of weeds in our lawn, aren't there? (No)
7. How about just staying home this year? (Yes)
8. What did you have for lunch today? (No)

Problems:

1. Ms. Farlan works as a receptionist. She was an hour late in getting to work one morning. Her boss asked her how come. Tell whether or not each of the following explanations is relevant.
   (a) She said her mother had telephoned her just as she was ready to leave for work. (No. This does not explain why she was an hour late.)
   (b) She said her car had run out of gas on the freeway on her way to work. (Kind of. This certainly accounts for some of the time, but does it account for an hour? She needs to elaborate on her story.)
   (c) She said she'd tried to call her boss at home to tell him she'd be late, but he had already left for work. (No. This has nothing to do with why she was late.)
   (d) She said she forgot to set her alarm clock and she overslept an hour. (Yes, assuming that she gets up with just enough time to get to work on time. Otherwise, her statement may or may not be relevant to her lateness, and it does not explain her being an hour late.)
   (e) She said she had trouble getting her car started this morning. (Not really. This could account for anywhere from 30 seconds to an hour or more. She needs to elaborate if she wants this to account for an hour.)
   (f) She said her morning newspaper was late in being delivered. (No)
   (g) She said she was up late last night. (No. The boss may infer that she overslept for an hour as a result of being out late, but her statement is not, by itself, relevant to her lateness for work.)

2. Mrs. Watson was applying for a job as a sportscaster at a TV station. The personnel manager asked what background she had to qualify her for the job. Tell which of Mrs. Watson's statements are relevant to the manager's question.

   (a) My daughter plays baseball in the Little League. (No)

   (b) I've been interested in all kinds of sports ever since I was about seven years old. (Yes)

   (c) I am not self-conscious about being in front of TV cameras. (Yes)

   (d) I am a very healthy person--hardly ever ill. (Yes. For a job like this, the TV station wants someone who will nearly always be there.)

   (e) My husband loves sports. He goes to watch games, and he watches all the sports he can watch on TV. (No)

   (f) I know the names and uniform numbers of every player in every major sport. (Yes)

   (g) I need the job. (No)

   (h) I have a college diploma. (No)

   (i) I have a diploma from SUPERIOR BROADCASTING SCHOOL. (Yes if the school does a good job; otherwise, no.)

3. You and a friend have a new game. You are reading the directions to find out how to play it. You come to a word you don't understand. Your friend doesn't know what it means, either. You read a little further but that doesn't clear up the word's meaning. Tell which of your friend's statements sound like good ways to find out what the word means.

   (a) Your mother is in the next room. Ask her. (Yes)

   (b) See how many vowels the word has. (No)

   (c) Look it up in the dictionary. (Yes)

   (d) Ask your two-year old sister. (No)

   (e) Write a letter to the editor of the newspaper you read. (No)

   (f) Spell it backwards and see if it makes any sense that way. (No)

   (g) We can figure out the game without knowing that one word, so let's not bother with it. (No. The statement may be true, but the question asks if the statement is relevant to determining the meaning of the word, not if the statement is relevant to finding out how to play the game.)

4. You now eat an ordinary bread. It is soft and tastes good. It has the usual vitamins added. You read an advertisement for HEALTH BREAD, a different brand of bread. Tell which of the ad's statements are good reasons for you to switch to HEALTH BREAD.

   (a) "The name alone tells you that you are missing something good if you don't eat HEALTH BREAD!" (No. The name doesn't have to have anything to do with the quality of the product.)

   (b) "This amazing new taste is the talk of the country!" (No. Maybe people talk about it because it tastes rotten.)

   (c) "Bart Johnson, the Olympic champion, eats HEALTH BREAD every day!" (No. They're probably paying Johnson to use his name for the ad. He might eat your brand instead if the company which makes your brand would pay him.)

   (d) "HEALTH BREAD is made from a special recipe!" (No. All breads are made from "special" recipes. If they weren't, they'd all taste the same.)

   (e) "You won't know what you've been missing if you don't try it!" (No. Big deal! This is true of about anything in the world, isn't it? You've never had your throat cut, either, but that doesn't mean you should try it so that you can find out what you've been missing.)

   (f) "HEALTH BREAD is made under scientifically controlled conditions." (No. About all that means in this context is that the manufacturing process is an efficient operation.)

   (g) "A loaf of HEALTH BREAD a day will supply your complete nutritional needs!" (Yes or no, depending on your situation. For example: Yes if you're short of money and a loaf of HEALTH BREAD costs less than you now spend for daily food; no if your present diet is adequate and you can afford to maintain it. We're assuming that your present brand does not supply your complete nutritional needs.)

5. Tricia is in high school. She wants to be a doctor. She is very good in everything except typing. But she is not doing well in her typing class and she wants to drop it. Her counselor thinks the class will be useful to her and thinks Tricia should not drop the class. Tricia is giving her reasons she should be allowed to drop the class. Tell which of Tricia's statements are relevant to the problem.

   (a) I don't need to know how to type if I'm a doctor. (No. School does not restrict teaching only to those things directly needed in one's chosen occupation. If Tricia later decides not to be a doctor, then the typing ability may provide her with a job.)

(b) I'm too uncoordinated to type well. (No. We don't have to be good at everything we try. Learning to type is a coordination hassle for many students, but they improve with practice.)

(c) I'll have to get a scholarship if I'm going to college because my parents can't afford to send me. The low typing grade is hurting my grade-point average, and that will lower my chances for a scholarship. (It depends. Perhaps something can be worked out with the typing teacher to allow Tricia to stay in the class so that she learns how to type but doesn't get a grade. No if this or a similar situation can be worked out; yes if it can't.)

(d) I don't like the class. (No)

(e) I've never done badly in a class before, and this is very upsetting to me. (No. This is relevant to a need for counseling, not to dropping the class. If something like this can be so upsetting to Tricia, what will be her reaction to her tough schedule as a medical student and as in intern?)

6. We're still on Tricia's problem. This time, her counselor is trying to talk her out of wanting to drop the class. Tell which of the counselor's statements are relevant to the problem.

(a) In college, you'll have many papers to hand in which must be typed. Typing them yourself will save having to hire someone to type them for you. (Yes if money might be a problem to Tricia; no if it won't be.)

(b) If you drop the class, you'll have a free period then. It's too late to put you in another class now. (No)

(c) Knowing how to type will make more summer jobs available to you while you're in college. (Same as (a) above.)

(d) Notes taken in college classes usually have to be rewritten to be much help in studying. Typing them at the end of each day of classes is faster than rewriting them, and typewritten notes are easier to read and study than handwritten notes. (Yes)

(e) I think you should stay in the class. (No)

7. Mr. Andrews is very upset with his son Mike. Mike drove the family car (with his father's permission) to a high school basketball game. Mike's team won. Mike was so excited that he didn't look all around as he pulled out of his parking place. His fender was damaged when it caught on the bumper of another car. Mike's father asked Mike, "How in the world could you have been so careless?" Tell which of Mike's answers below are relevant to the question.

   (a) You said I could use the car tonight, didn't you? (No)

   (b) It could have been a lot worse. I'm glad the other car wasn't hurt. (No)

   (c) Most of the other kids at school have their own cars. They don't have to drive their parents' car. (No)

   (d) Some of my friends were smoking after the game, but I didn't. Aren't you even glad about that? (No)

   (e) I know you're upset, and I'm sorry about it. (No)

   (f) It was an accident. (No)

   (g) I'll pay for it out of my own money, so it won't cost you anything. (No)

   (h) This is really going to look bad on my driving record, isn't it? (No)

   (i) Jack Wilson told me yesterday that he had an accident last week, and it'll cost $700 to get the car fixed. He said his dad was really nice about it. I don't understand why you're so upset. I won't cost any more than $35 to get the fender fixed. (No)

   (j) Remember when Mother had an accident with the car three months ago? She damaged the car a lot more than I did, and you weren't nearly as upset with her as you are with me. I don't understand why you're so mad at me about it. (No)

   (k) Will the insurance company raise the insurance premiums now because of this? (No)

8. Mario wants to be either a firefighter or a plumber, but he can't decide which he wants to be. He is talking about it with his friend John. John is trying to help him make up his mind. Tell which of John's statements sound like they are relevant to Mario's problem.

   (a) Firefighting is more dangerous than plumbing. (Yes)

   (b) I have a cousin who is a firefighter. (No)

(c) I have a cousin who is a firefighter and another who is a plumber. You could talk to them and hear what they say about their jobs. (Yes)

(d) Firefighters work around the clock. You couldn't always plan to go someplace at night, because you might have to work then. (Yes)

(e) You might not like firefighting. (No. He might not like any job, but a person usually doesn't know whether or not he likes it until after he's done it awhile.)

(f) You're not strong enough to be a firefighter. (Yes)

(g) Plumbers make more money than firefighters. Yes)

(h) There's a shortage both of good plumbers and of good firefighters. (No. We've already said Mike wants to be in one of the two occupations. This might be a relevant statement if John were trying to talk him into being a firefighter or a plumber instead of something else, but it is not relevant under the conditions stated.)

9. You are driving in the country. You get lost. You stop at a farmhouse to ask directions to the next town. The farmer gives you directions. Tell which of the farmer's statements are relevant to the directions you need. (Suppose that everything he tells you is true.)

(a) It's about five kilometers as the crow flies. (No)

(b) First, you have to keep going as you were for about a kilometer. (Yes)

(c) Some people got lost yesterday and stopped here for directions. (No)

(d) You look hot and thirsty. Come on in and have some lemonade. (No)

(e) Looks like rain. You'll have to hurry if you don't want to get caught in it. (No)

(f) Turn right at the first road you come to. (Yes)

(g) Watch for a white church on the left. That's where we go every Sunday. (No)

(h) Watch for a white church on the left. Turn right at the next road. (Yes)

10. Ms. Bingham works in the accounting department of a large company. Her boss has been finding fault with her work. He said he'd fire her if she doesn't get on the ball. Each statement below is one of the boss's criticisms. Tell which ones are relevant to the questions of whether or not Ms. Bingham should be allowed to keep her job.

    (a) You've worked here only six months. (No)

    (b) You've been late in getting to work at least once a week for the past three months. (Yes)

    (c) Your clothes are out of style. (No)

    (d) You never seem to recognize your own mistakes. Someone else always has to catch them. (Yes)

    (e) You don't need this job since you have income from other sources. (No)

    (f) Your typewritten work is very sloppy. (It depends on what her typewritten work is intended for. Yes, if it is to be a finished product such as a letter or a financial statement. No, if it is simply a memo which is quite readable (even though it has corrections on it) to someone else in the company.)

    (g) You said when we hired you that you would learn shorthand, but you have made absolutely no effort to learn it. (It depends on whether or not it is needed for her to do an efficient job. Yes if it is; no if it isn't.)

    (h) You still require constant supervision on work you were shown thoroughly how to do two months ago. (Yes)

Assignment:

1. Listen for irrelevant statements in campaign speeches.
2. Listen for irrelevant statements while watching TV.
3. Watch for irrelevant statements in newspapers and magazines.
4. Listen for irrelevant comments while with other people--friends, shopping, in other classes, wherever.

Bring to class any examples you find so that the class can benefit from the examples. The more examples you can find, the better you will become at recognizing other examples.

To the teacher: Present your class with various situations such as those in these problems, and ask each student to write at least five questions or comments about it. Then collect these and read them aloud one at a time. Ask the class to judge each one to be relevant or irrelevant.

(Adapted from Relevant Information by Anita Harnadek)

DAY 16 FALLACIES

Objectives:

1. Students will be able to analyze fallacies in reasoning through discussion and practice problems.
2. Students will be able to evaluate fallacies to determine the reasons they are unsound.
3. Students will apply critical thinking skills by finding examples of fallacies in everyday life.

(To the teacher: It would be helpful to have this information duplicated for the students so that they can refer back to it later.)

Discussion: A fallacy is an argument that is unsound. Although they are logically flawed, fallacies are usually persuasive and at first glance appear to be sound. There are many different kinds of fallacies. We have already dealt with three of them when we learned about faulty analogies, false cause, and irrelevant information.

Fallacies fall into three main categories--fallacies of ambiguity, fallacies of presumption, and fallacies of relevance. We will briefly go over each type of fallacy and the different forms they can take. Don't worry if you can't remember all the names of the different forms--they are confusing--just make sure you understand why each argument is fallacious (unsound).

1. Fallacies of Ambiguity

   A word or expression is ambiguous if it has more than one distinct meaning. Fallacies of ambiguity are arguments that are unsound because they contain words that, either alone or in combination, can have more than one meaning. Examples:

   (a) Dog for sale. It eats everything and is very fond of children. (Classified ad)

   (b) Killer Says Dead Man Was Chasing Him With Drawn Razor. (Newspaper Headline)

   (c) It's impossible to praise this book too highly.

2. Fallacies of Presumption

   Fallacies of presumption are arguments that are unsound because of unfounded or unproven assumptions in them. People using this fallacy can be guilty of overlooking essential facts, evading the facts, or distorting the facts.

A. Overlooking essential facts takes three main forms: sweeping generalization, hasty generalization, or bifurcation

1. A sweeping generalization results when a general rule is applied to a special case to which the rule does not apply.

> "Since horseback riding is healthful exercise, Harry Brown ought to do more of it because it will be good for his heart condition."

2. A hasty generalization is the reverse of sweeping generalization. An isolated or exceptional case is used as the basis for a general conclusion which is unwarranted.

> "I know one person from Waterloo, and he's a terrible person. I wouldn't trust any of them."

3. Bifurcation is an argument which uses "either/or" when other alternatives exist.

> "Either we must have war against Russia before she has the atom bomb, or we will have to lie down and let them govern us." (Bertrand Russell in 1948.)

B. Evading the facts results in four types of fallacies: begging the question, question-begging epithets, complex question, and special pleading.

1. Begging the question is committed when an argument simply restates the conclusion in another form instead of offering proof for its conclusion.

> "The belief in God is universal because everybody believes in God."

Arguments that beg the question are called circular arguments.

2. Question-begging epithets use slanted language which reaffirms what we wish to prove but have not yet proved. An epithet is a descriptive word or phrase used to characterize a person, thing, or idea. The epithet has little place in logic. Mud-slinging and name-calling are other terms for question-begging epithets. They use overstatement, ridicule, flattery, abuse, and the like to evade the facts.

"When one reflects on how this country's unemployment insurance program has encouraged the indolence of skid-row bums and Cadillac-driving welfare cheats, it becomes obvious that this legalized highway robbery must be revoked."

3. Complex question begs the question by assuming a certain answer to a prior question that was never asked. Other names for complex question are loaded question, trick question, or leading question.

"Have you stopped beating your wife?"

"Did John ever give up his bad habits?"

"Are you still a heavy drinker?"

Before answering the question, it is best to first question the question.

4. Special pleading is to apply a double standard, one for ourselves (because we are special) and another (a stricter one) for everyone else.

"I am firm; you are stubborn; he is pig-headed." (Bertrand Russell)

C. Distorting the facts is committed in three ways: false analogy, false cause, and irrelevant thesis. We dealt with these three fallacies in Lessons 13, 14, and 15. We will review them briefly here.

1. False analogy is an argument which makes the facts under discussion appear more similar to another set of facts than they really are.

"Why should we sentamentalize over a few hundred thousand Native Americans who were ruined when our great civilization was being built? It may be that they suffered injustices, but, after all, you can't make an omelet without breaking a few eggs."

Obviously, breaking eggs does not cause them pain, while building great empires by destroying people's lives does cause pain.

The best defense against distortion of facts by false analogies is always to sort out those aspects of the analogy that are relevant to an argument and those that are not.

2. False cause happens when we assume that two events are causally connected when they may not be.

> "More and more young people are attending high schools and colleges today than ever before. Yet there is more juvenile delinquency and more alienation among the young. This makes it clear that these young people are being corrupted by their education."

3. Irrelevant thesis is an argument in which an attempt is made to prove a conclusion that is not the one at issue. In logic, a thesis is like a conclusion.

> "I fail to see why hunting should be considered cruel when it gives tremendous pleasure to many people and employment to even more."

Whether hunting gives employment or pleasure to people is irrelevant to whether it is cruel to animals. The answer to all such fallacies is:

> "True, perhaps, but irrelevant."

3. Fallacies of Relevance

Fallacies of relevance are arguments in which the emotional appeal deceives us into believing that what is said is relevant to the conclusion. Six forms have been identified which attempt to enlist support for the conclusion through an emotional rather than a logical response.

A. Personal attack is an argument which attacks the person or persons associated with a question rather than attacking the question itself.

> "This theory about a new cure for cancer has been introduced by a man known for his Marxist sympathies. I don't see why we should extend him the courtesy of our attention."

B. Mob appeal is an argument in which an appeal is made to emotions, especially to powerful feelings that can sway people in large crowds.

> "No one in this room wants to deny any child a decent education. But let's remember that this is our school and it belongs to our children."

Mob appeal exploits our irrationality.

C. Appeal to pity results from trying to gain one's point by playing on people's sympathies.

"We're number two." (Avis Rent-a-Car's successful slogan.)

However moving, appeals to pity are irrelevant and should carry no weight with us.

D. Appeal to authority is made whenever we try to justify an idea by citing some source of expertise who is not an expert on the subject.

"This idea of supporting research on dolphins is ridiculous. We were discussing it during lunch today, and the treasurer, the president, and the personnel manager all agreed it's a colossal waste."

E. Appeal to ignorance is an argument that tries to make us believe something just because we cannot prove it is not so.

"There is intelligent life in outer space, for no one has been able to prove that there isn't."

F. Appeal to fear is an argument which the threat of harm to advance a conclusion.

"If you do not convict this murderer, one of you may be his next victim."

In summary, the following is a list of fallacies which make an argument unsound.

1. Fallacies of Ambiguity
2. Fallacies of Presumption
   - A. Overlooking essential facts
     1. Sweeping generalization
     2. Hasty generalization
     3. Bifurcation
   - B. Evading the facts
     1. Begging the question
     2. Question-begging epithets
     3. Complex question
     4. Special pleading
   - C. Distorting the facts
     1. False analogy
     2. False cause
     3. Irrelevant thesis

3. Fallacies of Relevance

   A. Personal attack
   B. Mob appeal
   C. Appeal to pity
   D. Appeal to authority
   E. Appeal to ignorance
   F. Appeal to fear

Problems: Using the chart and facts above, decide which fallacy was employed in each argument.

1. The verdict rendered by the jury was reasonable and just. Mr. Black, who was a member of the jury, is therefore a reasonable and just man. (Sweeping generalization)
2. Haste makes waste, because hurried activity is always careless activity. (Begging the question)
3. Tourists taken in. (Road Sign) (Fallacy of ambiguity)
4. No breath of scandal has ever touched the Senator. Therefore, he must be incorruptibly honest. (Appeal to ignorance)
5. It must be so. I read it in a psychology book. (Appeal to authority)
6. The barometer is falling; therefore, it will rain. (False cause)
7. "We're worried about your son, Mr. Norris," says the sixth-grade teacher. "He seems lazy. He persuades young Steward to do all his work." "Lazy!" exclaims Norris, "That's executive ability." (Special pleading)
8. There are two kinds of people in this world: the "haves" and the "have-nots." (Bifurcation)
9. You'd better find the fallacies in these arguments and identify them correctly, for if you don't, I'll know you haven't been paying attention in class. (Appeal to fear)
10. Student government is a mistake from the beginning. Look what happens in homes where parents let the children run things their own way! (False analogy)
11. Which one of you left the door open? (Complex question)
12. There's no point in listening to what you have to say: everybody knows you're on the radical right. (Personal attack)
13. Doctors are all alike. They really don't know any more than you or I do. This is the third case of faulty diagnosis I've heard of in the last month. (Hasty generalization)

14. TV can't be harmful to children, because it occupies their attention for hours and thus keeps them off the street. (Irrelevant thesis)

15. I'm on probation, Sir. If I don't get a good grade in this course, I won't be able to stay in school. Please, could you let me have at least a C? (Appeal to pity)

16. I'm surprised at you. A man of your culture and upbringing--defending these hoodlums! (Question-begging epithets)

17. Because you are a college audience, I know I can speak to you about difficult matters seriously. (Mob appeal)

18. Our X-ray unit will give you an examination for tuberculosis and other diseases which you will receive free of charge. (Ambiguity)

19. Why should mine workers complain about working ten hours daily? Professional people often work at least that long without any apparent harm. (False analogy)

20. I will not commit this act because it is unjust. I know it is unjust because my conscience tells me so; and my conscience tells me so because the act is wrong. (Begging the question)

21. It's clear that Jones is an innocent man. He was tried for the crime before a jury of his peers and the prosecution was unable to prove him guilty. (Appeal to ignorance)

22. Because Jones is an outstanding quarterback, the team on which he plays must be an outstanding team. (Hasty generalization)

23. Better dead than Red. (Bifurcation)

24. If we really believe in the right to life, liberty, and the pursuit of happiness, we'd have abolished prisons long ago. (Irrelevant thesis)

25. We're all Americans here, and we all share one ideal. (Mob appeal)

(Adapted from With Good Reason by S. Morris Engel)

DAY 17 OPEN-ENDED PROBLEMS

Objectives:

1. Students will use skills of analysis, reflection, group discussion, synthesis of knowledge from various experiences, and observations in developing solutions to problems.
2. Students will broaden their ranges of thinking by listening to others' ideas.
3. Students will explore, question, and enlarge upon each other's suggestions.

To the Teacher: The problems in this lesson are meant to be discussed as a class, not written. The idea behind these problems is to encourage as many solutions as possible, so they learn from each other's thinking. In the answers are many suggestions for questions to be asked during the discussions. Give the students room to think for themselves. Try to stay in the background during the discussions. At times, it may be apparent that the class has exhausted its knowledge and yet has not reached a satisfactory answer to the problem. Encourage the students to think about the problem some more and, perhaps, to do some additional reading for more background information, with the idea that the discussion will be taken up again the next day.

Problems:

1. Kitty thinks she's old enough to start choosing some of her own clothes. Her parents think she isn't. Kitty is willing to be convinced that she isn't old enough. Her parents are willing to be convinced that she is old enough.

   (a) What might Kitty do to convince her parents that she's old enough to start choosing some of her own clothes?

   (Keep in mind that she might not, in fact, be old enough to choose some of her own clothes. But if she is, she might start by specifying that she would like (1) permission to choose only certain types of clothing for the time being--say, slacks or blouses or sweaters; (2) to have a clothing allowance of her own to cover the cost of these items so that she can either spend it as she gets it or save up for a particular item; (3) to go shopping for these items alone; (4) some freedom to make mistakes, since she's the one who'll be stuck with any unsatisfactory clothing she buys, and since it will be agreed that

she will not get any extra allowance to replace any unsatisfactory clothing she buys; (5) a trial period long enough to learn from her mistakes without being thought (by her parents) to be too young to learn to choose wisely. She might amend item (3) by asking that one or both parents go with her the first two or three times to see what she would be likely to choose on her own and to offer suggestions and advice if she tended to choose something which would later be unsatisfactory.)

(b) What might Kitty's parents do to convince her that she isn't old enough to start choosing some of her own clothes?

(Keep in mind that Kitty might be, in fact, old enough to start choosing some of her own clothes. But if she is not, they might take Kitty with them the next time they go to buy clothes for her. She should be told how much money is available, and she should be given a list of the clothing she is to buy with the money. Then her parents should turn her loose (but stay with her) to decide what to buy and what not to buy. Instead of actually buying an item, however, Kitty is to pretend she bought it and so has less money left for the other items on the list. At the end of the shopping trip, if Kitty is really not capable of choosing her own clothing wisely, the clothing she chose will probably have one or more of these faults: (1) it is not appropriate for all the places it is to be worn; (2) it is the wrong size; (3) it is not well-made; (4) the upkeep is too expensive (for example, white wool slacks which would have to dry-cleaned after practically every wearing); (5) she spent all the money on some items, leaving other needed items unpurchased. Many other faults are possible, of course. To be fair, Kitty's parents should then say that they did not really expect her to do a good job on her first try, and they will give her another chance. They should then take her on another shopping trip a week or so later.)

2. Jeremy's family is very poor. He'd like to get a job to help out. He is only ten years old, so he can't get working papers which allow him to work someplace like a gas station or a grocery store or a restaurant. What might Jeremy do to earn some money to help out his family?

(He might try many things, among which are: (1) check with his neighbors to see if they need odd jobs done, errands run, housework help (mopping floors or washing windows, for example), baby-sitting services, lawns mowed, weeds pulled, or snow shoveled; (2) buy a can of

white paint, a can of black paint and some stencils for numbers. Go from door to door and offer to paint house numbers on curbs for, say, $1.50; (3) see if he can get a paper route; (4) make things (maybe jewelry or belts or puzzles) and sell them door-to-door.)

3. You are playing baseball with some friends. A batted ball hits the pitcher on the head and knocks her down. She is dazed for a few seconds, but then she gets up and says she feels fine. She is not bleeding. You know that this kind of injury can be very serious. What should you do?

   (Keep the pitcher quiet. If she is sitting, have someone stay with her in case she faints so she doesn't hit her head again. Figure out a way to get help for her. (Are there houses around so that you could ask to use the telephone to call her parents? Is her house near? What if no one is home at her house? Should you call the emergency medical service? What if they refuse to treat her unless they have her parents' permission? Should you ask some adult you can find to drive her to the nearest hospital emergency room? What if the adult says he or she doesn't want to get involved?)

4. Wally thinks his teacher picks on him more than on the other kids. It seems to Wally as though the teacher always saves the hardest questions in class for him. It seems as though the teacher is forever making little remarks to cut Wally down. One day Wally tripped on the way to school and got his homework paper dirty when he fell, and the teacher said he had to rewrite the paper. One day Wally came in without his homework done and the teacher made a big federal case out of it. When Wally talks to a classmate during class, it seems as though the teacher has a lot more to say to him about it than the teacher says to other kids who talk during class. Wally definitely believes the teacher is treating him unfairly. What might Wally do about it?

   (Wally might talk to his classmates about it and see if they agree he's being treated differently than the other students. If they disagree, it may be that Wally just notices more when he's the target than when another student is the target of the teacher's remarks. If Wally's classmates agree that he's being treated unfairly, then Wally should have a list of examples ready when he does this, rather than just make some general statement such as, "I think you're picking on me, and the other kids do, too. How come you don't treat me like you do everyone else?" If the situation doesn't improve, then Wally should talk to his school counselor or the principal. If the situation still doesn't improve, then he should talk to his parents about it. At each step of talking to someone else, Wally should have a list of examples showing things that have happened since the last time he talked to someone about it.

5. Mike has a hard time with arithmetic. He doesn't really understand what's going on with fractions and decimals. He can learn how to work them well enough to pass a test when he has to. But a week later he's forgotten again how to do the problems. What might Mike do in order to understand arithmetic better?

   (He could ask other people for help--his parents, his brothers or sisters, other relatives, his friends, his teacher. He could keep an open mind about learning so that when someone explains in a different way or shows him a different way to get an answer, he doesn't automatically say, "No, you're confusing me. That isn't the way I learned to do it." (If he'd really learned how to do it, he wouldn't be asking for help, would he?) He could study the explanations in his arithmetic book. He could ask his teacher for other books and then read the explanations in them. He could ask his teacher for some extra problems to do for practice. He could get extra problems from the other books or make up his own problems to do and then ask someone else to check them (teacher, parents, friends, etc.).)

(Adapted from Open Ended Problems
by Anita Harnadek)

DAY 18 APPLICATIONS

Objectives:

1. Students will be able to apply knowledge gained in this unit to everyday situations through use of information gathered from newspapers, magazines, television, radio, advertisements, and other people.
2. Students will evaluate the information gathered for examples of logical or illogical thinking.
3. Students will gain from each other's thinking by listening to the other students' opinions in class discussion.
4. Students will demonstrate their creativity through individual or small group projects.

Activities: Students will hopefully have collected, by this time, a number of examples from outside the classroom of faulty reasoning. The teacher, too, should have gathered a file of such examples for class discussion. Several options are available for making use of these. Listed below are a few of them.

1. The teacher can read each example to the class and have the class discuss and debate its merits.
2. The examples could be catergorized according to type. The class could be divided into several committees, each taking a different type to analyze and report on the class.
3. A survey could be taken of the examples collected to see which are most prevalent. The class should discuss why they think this is so. Would this trend hold up if they had ten times or 100 times as many examples? Why?
4. A survey of people not in this class could be taken to see if others can detect the faulty reasoning or if they agree with it.
5. Small groups could develop plays which portray logical or illogical thinking.
6. Read the story, "Love Is A Fallacy" from the novel The Many Loves of Dobie Gillis (reprinted in S. Morris Engel's With Good Reason--see Bibliography). This story provides a delightful, if extreme, illustration of how fallacious reasoning can affect our everyday lives. Ask them to write their own stories in which the characters are in some affected by logical or illogical thinking.

7. Have students take opposing viewpoints on controversial issues and try to persuade the class to agree with them using logical (or illogical) thinking. Have the class identify specific examples used in their speeches which showed sound or unsound conclusions.

8. Have the students bring records from home which attempt to persuade or argue or convince someone of something. See if the class can identify any fallacies or false conclusions.

9. Artists in the class may wish to create cartoons or other illustrations which depict logical or illogical thinking.

10. Have the class create their own advertisements for a certain product which will convince the public to buy it. Evaluate each for the types of logic used.

DAY 19 UNIT REVIEW

Objectives:
1. Students will review notes, discussions, problems, and examples used in the unit to be sure that the concepts are clear.
2. Students will list questions, concerns, or problems which need clarification.
3. Students will help each other in understanding difficult concepts by taking turns sharing problems with the class.

Activities: This should be a day to tie up loose ends. Any activities that were not finished from previous days should be completed. Students should have opportunities to ask questions, give opinions, and evaluate the answers of others. This should be a time to solidify the many concepts learned in this unit in their minds. Questions should be brought up to the entire class so that everyone gets the benefit of the answers.

DAY 20 POST-TEST

Objectives:
1. Students will demonstrate the knowledge gained during the unit.
2. Students will show whether gains have taken place in their ability to think critically and logically.

Directions: Administer the test making sure there is adequate time for everyone to finish. When all have finished, go over the test if time permits. Students will undoubtedly have questions about the test they will want answered. They will want an opportunity to discuss some of the problems with you and with each other..

Grading the test: There will obviously be some leeway given in the answers when a reasonable explanation is given for a different answer. However, most items were selected because the answers were pretty clear cut. Try to look for the thinking processes used as well as the right answers.

Comparing the Pre- and Post-Tests: The scores from the two administrations should be analyzed to see where students had problems. Both scores plus the difference score (+ or -) should be recorded. Students should be able to see how much growth they achieved.

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